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A REVIEW OF STANDARDS ACTIVITIES

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 208 **September, 1955**

Technical Committees in Action

A REVIEW OF STANDARDS DEVELOPMENT

In line with the ever-increasing development of new and improved materials and the continuing demand for improved performance of existing materials, the work of ASTM technical committees proceeds apace. That materials standards are an important part of our expanding industrial economy has been amply proved by the wide acceptance and use of ASTM standards. Once on the books, a standard continues to be a dynamic thing, and revisions are made as often as necessary to maintain progress. Out of the research laboratories are pouring a variety of new materials—many with strange and interesting properties. These too need the kind of dynamic standards that ASTM technical committees are so well equipped to provide. Behind the printed standards are untold man-hours of committee work and round-robin testing. The reward for this voluntary co-operative effort is the knowledge and satisfaction of a job well done.

An important feature of each year's September BULLETIN is an account of the standards activities for the coming year. Further details may be found in the July issue of the BULLETIN as well as in the annual reports of the committees. Certain committee reports do not appear in this issue because they either were adequately covered in the July issue or will appear in a future issue.

METALS

New Uses, Severe Demands Spur Metals Standards Work

TENTATIVE Specifications for Alloy Steel Chain (A 391) were recommended by **Committee A-1 on Steel** for publication at the 1955 Annual Meeting. However further revisions are under consideration and a 1956 version will probably result. Also Standard Specifications for Iron and Steel Chain (A 56) need to be brought up to date, and work is in progress on these specifications which have not been revised since 1939.

Tentative specifications for chromium silicon steel valve spring wire and another for chromium silicon steel spring wire are in final stages and will be submitted to the Society for approval for publication early in 1956. The need for specifications covering a high-tensile strength carbon-steel valve spring wire is under consideration and work has begun on specifications for upholstery spring wire.

A method for sampling steel forgings for analysis for hydrogen content is under way. This will be turned over to Committee E-3 after the preliminary stages have been reached. Specifications for forged and hardened steel rolls will be the subject of many discussions in 1956. A task group investigating brittle fracture of large forgings has met quite frequently in 1955 and further meetings are planned.

Proposed specifications for welded light-wall stainless steel pipe up to 30 in. in outside diameter are being developed and can be expected in 1956. Proposals have been made to add type 348 stainless steel (columbium-tantalum grade) to all the tubular specifications which now include type 347.

The Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers has requested ASTM to prepare specifications for a copper-nickel-chromium plate steel as covered by ASME Code Case 1202 and an intermediate manganese steel as covered by Code Case 1056. Work has started on these projects.

1956 appears to be the year when the format of all ASTM specifications covering carbon and alloy steel bars will be revised. A general requirement specification will cover all the items common to the specification, with quality requirements remaining in the individual product specification. A guide for purchasing steel bars according to "ruling section" is in its final stages. The question of the proper form for publishing this guide is to be discussed with ASTM Headquarters.

The special subcommittee on bearing steel has been reorganized under the chairmanship of E. S. Rowland of The Timken Roller Bearing Co. The task immediately at hand and being worked upon is the development of quality specifications for carburizing grades of steel for use in antifriction bearing.

• Although not yet confirmed by letter ballot, it appears that **Committee A-3 on Cast Iron,** through the American Standards Assn., will participate in the work of Technical Committee 25 on Cast Iron of the International Organization for Standardization. The next meeting of Technical Committee 25 is scheduled for September, 1955, and American representatives are expected to attend.

In answer to a request of the ASME Boiler and Pressure Vessel Committee, new specifications for nodular iron for pressure-containing parts ranging from −20 F to elevated temperatures are expected to be published late this year and early in 1956. Two other nodular iron specifications, one for quenched-and-tempered material and another for gas and water line pipe, are being developed.

• Supplementing the specifications on galvanizing assembled steel products and the recommended practices for safeguarding against warpage and for design suggestions to obtain good galvanizing, **Committee A-5 on Corrosion of Iron and Steel** is now studying zinc coating on hardware, shapes, bolts, and such items as are used for steel transmission towers with the view to specifying increased weight of coating as soon as this is commercially practicable.

The sheet subcommittee is continuing its study of the sampling pro-

cedure in Tentative Specification for Long Terne Iron or Steel Sheets, Coils, and Cut Lengths (A 308).

Plans have been completed for a new test on hardware involving atmospheric exposure tests of zinc and aluminum coatings on carbon and alloy steels at New York City and Kure Beach, N. C.

The wire-test specimens which have been exposed for 18 years at eleven sites and the sheet-test specimens which have been exposed for almost 30 years are continuing. The practice has been to report biennially on these tests—the wire tests in the odd number years and the sheet tests in the even number years. The committee is also cooperating with the American Welding Society in the inspection of AWS specimens of metallized coatings of zinc and aluminum on steel panels which are exposed at ASTM test sites.

• The work of two task groups of **Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys,** the results of which should be of considerable practical value in structural and architectural design, is continuing. The task group on inspection of corrosion-resistant steels in architecture and structural applications has made periodic inspections of a number of stainless steel installations on various buildings in Pittsburgh, New York City, Atlantic City, and Philadelphia, and of the Reading Railroad stainless steel train "Crusader." The work of a second task group on Inspection of Nickel-Bearing and Non Nickel-Bearing Stainless Steels was initiated in 1953 with the installation of nine grades of stainless steels at the Pittsburgh and New York sites.

Progress has been made in procuring specimen materials for the large-scale program of atmospheric tests of stainless steels. It is expected that the tests will be under way by the early part of 1956.

A special task group has been appointed to survey current research programs on stress corrosion of stainless steels. The results of this survey will determine whether any specific activity should be undertaken in this field. Another group is investigating the desirability of preparing specifications for the newly developed chromium-manganese austenitic alloys.

Having completed an initial assignment of preparing the prototype patterns detailing those items which should be specified for each of three classes of super-strength alloys, these groups have proceeded to the succeeding step—that of compiling the several lists of specific alloys which fall into each classification. This is preliminary to the specification writing.

• Statistical sampling procedures for tin-coated soft copper wire (B 33) and for lead-coated and lead-alloy-coated soft copper wire (B 189) will very likely come from **Committee B-1 on Wires for Electrical Conductors** in 1956. Much of the necessary test data has been compiled, but additional data on the larger sizes of wire are still being collected.

A large amount of data using the low stress elongation (LSE) test for stiffness of bare magnet wire has been collected. These will be analyzed with a view toward establishing limiting values for specification requirements.

The Signal Corps Engineering Laboratories at Fort Monmouth, N. J., last year contacted the committee regarding the possibilities of tin transformation when tin-coated copper wires were exposed to arctic temperatures. A task group was organized to work with the Signal Corps and a program for longtime cooperative tests has been arranged.

• For several years **Committee B-2 on Non-ferrous Metals and Alloys** has worked on a proposed classification of tin. Though this has proved a difficult problem, it continues as an active project.

Proposed specifications under consideration include one for pig lead of secondary origin, and others for nickel-molybdenum-chromium alloys and nickel-molybdenum alloys in cast and wrought form.

• **Committee B-3 on Corrosion of Non-ferrous Metals and Alloys** has since 1948 exposed at periodic intervals panels of zinc and of steel in an effort to calibrate the corrosivity of the various ASTM test sites. This program will end in 1956. Preliminary results indicate that the weight losses resulting from one year's exposure of these panels will give a good idea of the relative corrosivity.

Data have been published on the results of Part I (disk-type) and Part II (wire-wound bolts) of the three-part program designed to investigate the corrosion rates of magnesium coupled with other metals. The pilot scale-corrosion tests of the third part of the program have been concluded. An analysis of these tests will indicate the type of test specimen which will be most suitable for evaluating the corrosion of the magnesium groups in plate-type form. Commitments for some of the test materials have already been obtained.

• **Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts** is continuing work on the revision of Method B 70 for determining change of resistance with temperature. The report of one more laboratory is needed before the revision will be proposed. This will necessitate changes in Specifications B 82 and B 83 covering wrought alloys for electrical heating elements.

Three formal reports have been presented suggesting specific procedures for including a life test for the iron-chromium-aluminum type alloys in Method B 76.

The committee is still attempting to formulate a clear definition of "green rot" attack and to obtain specific examples of the phenomenon. Many failures classified as "green rot" are actually unrelated.

• **Committee B-5 Copper and Copper Alloys** is reviewing the basis of purchase sections of the various specifications covering flat products with a view toward revision. Requirements for tin-coated copper are also being prepared; flatness tolerances of Condenser Tube plates (B 171) will probably be revised, and the addition of a hardness conversion table to Specifications B 194 for copper beryllium alloy is under study.

Among the subjects being considered are the revision of chemical requirements for rod of type OF copper, addition of leaded nickel silvers of lower nickel content to Specifications B 151, and in Specifications B 139 for phosphor bronze, the clarification of requirements for test specimens.

In Specifications B 159 (phosphor bronze) the revision of chemical requirements for alloy A and provisions for stress relief annealing of alloy A spring wire are under study. The nickel-silver Specifications B 206 will probably be revised by changing the chemical requirements for alloy C and adding requirements for a 10 per cent nickel silver.

Under review are the temper requirements in Specifications for Copper Seamless Tube (B 75) as well as the chemical requirements for OF copper. In Specification for condenser Tubes (B 111) revision of requirements for the expanding test and

the mercurious nitrate test in addition to review of dimensional tolerances are under way. A new specification for copper-silicon alloy pipe and tube is being prepared.

Being considered are the revision of chemical requirements for silicon bronze and silicon brass in Specification B 198, and the assembling of data on properties of cast copper-base alloys.

• **Committee B-6 on Die-Cast Metals and Alloys** agreed in the spring of 1952 to expose at New York City and Kure Beach, N. C., specimens of aluminum die-cast bars of SC84A alloy. The purpose of the program was to determine the effect of zinc contents varying from 0.25 to 2.0 per cent. The one-year tests were completed in 1954 and the data appear in this year's annual report. The remaining bars will remain on exposure for periods of 3, 6, and 12 years. The committee has also removed three sets of alloy test bars designated IVa, V, and Va. Alloy IV is a 5 per cent silicon alloy and Alloy V is a 12 per cent silicon alloy—the "a" designation indicates the use of a high-purity aluminum. The results of these 20-yr tests will appear later as will the 10-yr data from exposure of aluminum alloys 281 (G8A) and 360 (SG100A) exposed at New York City.

Mechanical properties are being determined for the aluminum-base alloys in Specification B 85 and these data will appear in an appendix to that specification. In addition, it is planned to include in Specification B 85 a table of die-casting and other characteristics.

A task group is currently recording the evolution of the present zinc die-casting alloys and describing the relative differences. It is expected that the work of this group when completed will be of great interest to anyone interested in the history of zinc die-casting.

• **Committee B-7 on Light Metals and Alloys, Cast and Wrought** is investigating the possibility of color identification for inclusion in a revision of B 179. It is expected that a draft of a proposed specification for aluminum alloy rivet and cold heading wire and rod will be prepared prior to the next meeting. Also in preparation is a specification for heat-treated high-strength aluminum bus conductors.

The atmospheric exposure program of wrought and cast aluminum and magnesium alloys at New York City, State College, Pa., Kure Beach, N. C., Point Reyes, Calif., and Freeport, Tex., is continuing. The results of the one-year tests on these materials was appended to the annual report in the form of a paper by L. H. Adam, chairman of the Subcommittee on Atmospheric Exposure Tests.

• **Committee B-8 on Electrodeposited Metallic Coatings** is continuing inspection and rating of steel panels plated with copper-nickel-chromium and steel panels coated with lead. Future tests of copper-nickel-chromium and nickel-chromium on steel will be carried out with exposures at New York City, Kure Beach, N. C., State College, Pa., and Detroit, Mich., so as to obtain typical corrosion patterns and rating numbers.

Inspection and rating of exposed steel panels coated with zinc and zinc plus conversion coatings are being continued.

The committee will investigate the performance of electrodeposited tin and tin-alloy coatings. Also under study are indentation hardness tests as applied to electrodeposits, methods of measuring ductility of electrodeposits, methods of measuring stress in electrodeposits, and a study of the effect of temperature on the service life of electrodeposited and hot-dipped zinc coatings with special emphasis on the effect on ductility of various basis metals.

Cadmium-plated panels with and without supplementary treatments will be exposed in the near future at Kure Beach, New York City, and at the Rock Island Arsenal.

• **Committee B-9 on Metal Powders** has found the problem of determining particle size distribution in the low micron range of refractory-metal powders extremely difficult and will seek the help of the ASTM Administrative Committee on Research.

Work is progressing on proposed tentative specifications for sintered iron structural parts. Also in preliminary stages are specifications for high-density iron parts.

The committee is planning to work on specifications covering standardization, chemical composition, physical and mechanical properties of machinable heavy metals; also, to investigate the possibility of specifications applicable to radiation-shielding uses for this type of material.

• **Joint Committee on Effect of Temperature on the Properties of Metals** will continue its practice of making available in one source all of the elevated-temperature data for a particular material. The Data and Publications Panel has completed "Elevated Temperature Properties of Carbon Steels," which will be followed by "Elevated-Temperature Properties of Copper and Copper Alloys" and a survey on relaxation data. The data collected on aluminum and magnesium alloys will be organized looking toward future publication.

Two active projects under the direction of the Gas Turbine Panel are a study of the oil ash corrosion problem and a study of thermal shock.

Under project SP-5 of the Steam Power Panel, a cooperative effort of the Edison Electric Inst. and the Joint Committee Task Force has been organized to gather and correlate relevant work being carried on in various agencies on the use of austenitic steels for steam line service.

A review of the available information on the subject "Steam and Air Oxidation of Low-Alloy Ferritic Steels to 1100 F" obtained under project SP-1 has been completed and is being put into shape for presentation.

• **Committee E-2 on Emission Spectroscopy** is continuing its work on development of tentative methods of emission spectroscopy and expects that a number of such tentatives can be prepared for publication within the coming year. The variety of equipment and techniques used in different laboratories has presented a real problem in accomplishing sufficient standardization of methods to permit their publication as tentative. However, several tentatives have been substantially completed and work on others is progressing. Because of the urgent need for methods of analysis of titanium, particular attention is being given to the development of such methods.

• **Committee E-3 on Chemical Analysis of Metals** is attempting to complete as many new and revised methods as possible within the coming year for inclusion in the next edition of the Book of ASTM Methods for Chemical Analysis of Metals. Plans to bring this book out in 1955 have been revised with a 1956 date in mind in order that a number of methods now being prepared can be included in the book.

Division F on Ferrous Metals is preparing methods for analysis of ferroboron and the procedure for the determination of boron in ferroboron should definitely be ready for publication within the coming year. Procedures for the analysis of steel and

iron for aluminum, columbium (niobium), tantalum, magnesium, photometric copper, photometric nickel, sulfur, zirconium, and rare earths (in stainless steel) are also in preparation. Work on hydrogen in steel is being undertaken in cooperation with Committee A-1 on Steel.

The committee is preparing a method for the determination of cadmium in silver solders and additional methods for analysis of electronic nickel, to be added to the present Methods E 107, should be completed within the coming year. Also in preparation are methods for the analysis of fire-refined copper, including the determination of arsenic, antimony, selenium, tellurium, bismuth, lead, and copper. Methods for zirconium in nickel and nickel-base alloys, for magnesium and zinc in aluminum-base alloys, and for iron in zinc are also being developed.

The committee through its Division S on Sampling is cooperating with Committee A-1 on methods for sampling tubular steel products. The committee is also preparing methods for sampling titanium sponge and is reviewing all other methods for sampling metals to determine whether any changes should be made in them.

The committee expects to have ready for publication as tentative, methods for analysis of titanium based on the Watertown Arsenal methods. Members of the committee have cooperated in the preparation of the Watertown methods. The determinations expected to be completed include aluminum, tin, vanadium, nitrogen, manganese, and magnesium. Methods for analysis of the newer high-nickel, high-cobalt alloys including procedures for determining molybdenum, iron, chromium, and tungsten are being developed. New methods in preparation for electrical heating alloys include photometric manganese and photometric copper. A task group is being set up to study vacuum fusion methods for oxygen, hydrogen, and nitrogen, and a method for determination of carbon, in electronic nickel.

Division G on General Analytical Methods is reviewing all new and revised analytical methods prepared by other divisions of the committee to determine what revisions should be made in the Recommended Practices for Apparatus for Chemical Analysis of Metals (E 50). The committee has turned over to Committee E-1 on Methods of Testing the results of its studies thus far on performance requirements for analysis balances. It is expected that cooperative work between the committee and Committee A-1 will make it possible to add precision and accuracy statements to a number of the determinations covered in the Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron (E 30).

Work will be continued on methods of analysis of metal powders. These tests will cover both ferrous and nonferrous metals or combinations of them.

As noted above, methods for determination of gases in electronic nickel and in steel are being developed. It is also expected that in the near future methods will also be developed for the determination of gases in metal powders and in titanium. Some of these methods will undoubtedly employ the vacuum fusion technique, which represents an addition to the techniques now employed in the current methods for analysis of metals.

• Nearly 1000 terms relating to metallography have been compiled by **Committee E-4 on Metallography** as a revision to Definitions of Terms Relating to Metallography (E 7). The revised document will probably be published late in 1955 or early in 1956.

Intensive efforts have paid off on reviewing the various grain size charts for steel, copper, and nonferrous metals. It appears that one chart can be issued covering all metals and alloys.

The subcommittee on electron microstructures continues its work in both ferrous and non-ferrous metals. Progress reports or review papers are expected in 1956.

CONSTRUCTION MATERIALS, CEMENT, MASONRY

Dynamic Standards for the Building Industry

• The effect of mechanical mixing in the testing of mortars has led to recognition by **Committee C-1 on Cement** of the need for revisions in physical-requirement values, including strength in several ASTM standards. Projects in this category include a review of the current tensile strength requirements in the Specification for Portland Cement (C 150) and a change in the procedure of testing for tensile strength (C 190) from the manual to the mechanical type of mixing. The effect of mechanical mixing will also be studied with respect to the Method of Test for Bleeding of Cement Pastes and Mortars (C 243).

A new cooperative series of tests will be carried out to obtain data needed in a revision of the Method of Test for Calcium Sulfate in Hydrated Portland-Cement Products (C 265). Publication is anticipated of a report, on the cooperative studies of a performance test for the potential sulfate resistance of portland cement and a proposed method of test for sulfate resistance. It is expected that the preparation of check samples of cement for use in calibrating flame photometers will be completed in the near future, these samples to be made available by the Portland Cement Assn. Cooperative studies on the determination of Darex in portland cement are continuing with the design of the apparatus being the most critical project. A review will be made of the use of the reagent ethylene-diamine-tetra-acetic acid for the determination of calcium oxide and magnesium oxide.

Projects under consideration on blended cement will include the development of a test for determining the amount of grinding aids, such as TDA and 109-B, as applicable to the Specifications for Portland Blast-Furnace Slag Cement (C 205).

• A new method of test to determine yield has been proposed by **Committee C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements.** It will show yield in terms of pounds of dry mix per square foot of floor when gaged with the correct amount of magnesium chloride solution. The data on this new method will be studied by the committee during the year. The need for additional definitions and terms is recognized and further consideration will be given to the subject.

• A complete reorganization of the subcommittee structure is being effected by **Committee C-3 on Chemical Resistant Mortars** whereby the future work of the committee will be handled by two groups of subcommittees. One group of four subcommittees will cover all materials within the scope of the committee; the group will be concerned with mechanical, physical, and chemical properties as well as recommended practices and identification. A second group of four subcommittees will be responsible for

specifications for silicate, resin, sulfur, and hydraulic mortars.

Work is under way to establish the appropriate test conditions for measuring tensile and compressive strength of silicate mortars and also for determining their apparent porosity and absorption. Three methods of determining linear thermal expansion of resin mortars are being tested to establish the merit of each. Also in the field of resin mortars consideration is being given to revision of a proposed method of determining water absorption and weight loss, which will incorporate a longer conditioning period.

• **Committee C-4 on Clay Pipe** will review the specifications for clay pipe anticipating further changes in crushing-strength values.

• **Committee C-7 on Lime** has several projects under way in the field of chemical lime, including a revision of the specification for lime for silica brick manufacture; a specification for lime for sand-lime brick; and a specification for lime for hypochlorite bleach manufacture. Suitable testing methods are needed to show delayed expansion before the specification for lime for silica brick manufacture can be completed.

The evaluation of two proposed lime neutralization testing procedures has progressed to a point where another round-robin test series is expected to complete the accumulation of necessary data. Available methods for determining free calcium oxide will be studied for recommendation to the committee of a preferred method. Data and test methods utilizing versenates for determining calcium and magnesium will be circulated for possible future work.

Development of a proposed specification and a definition of pozzolan as used with lime will be undertaken. This represents a new field of coverage by the committee and it will serve to supplement the interest in pozzolanic materials in the cement and concrete committees. Research work will be continued on the difficult problem of determining the soundness of limes used in masonry mortar.

• **Committee C-8 on Refractories** has in progress a study correlating modulus of rupture values from a miniature hot load test and from a standard hot load test. Chemical methods under development include tests for hydration of magnesia refractories and a test for alkalies using the flame photometer. Studies are being made to test for the consistency of plastic and castable refractories.

Physical and chemical methods for refractory dolomite are under preparation. Considerable study is being devoted to the preparation of classifications for raw, calcined, and deadburned refractory dolomite.

The committee is also preparing new surveys on refractories for the forthcoming edition of the Manual of ASTM Standards on Refractory Materials.

• Activity of **Committee C-9 on Concrete and Concrete Aggregates** in the revision of existing standards and the development of new standards continues unabated. The committee plans to develop a method for evaluating compressive strength of concrete. The use of radioisotopes is under discussion for studying chemical reactions of aggregates in concrete. Consensus has not yet been reached on a definition of the term "creep" in the study of elastic and plastic properties of concrete. Other properties than creep, such as shear strength, will be studied by the appropriate subcommittee. The real significance of freezing-and-thawing tests is being evaluated and also attention is being given to the effect of air entrainment. A recommended practice for the determination of undesirable materials in aggregates is being considered by the committee.

Plans have been made to study and compile field-condition data with freezing-and-thawing tests in connection with the deterioration of concrete due to physical characteristics of aggregates.

The development of a specification for natural pozzolanic materials is expected to be completed, as well as revisions in the current Tentative Specifications for Fly Ash (C 350) and Air-Entraining Admixtures for Concrete (C 260). Work continues in developing data on a proposed method for determining abrasion of concrete. Two methods for measuring the setting time of concrete involving the Proctor needle and the use of embedded steel pins are being studied and comparative test data are being collected.

The greatly expanded and revised publication covering the significance of tests and properties of concrete and concrete aggregates is expected to be published this fall.

• The physical characteristics of soils will receive particular attention from **Committee D-18 on Soils for Engineering Purposes** along with a critical review of Tentative Method of Mechanical Analysis of Soils (D 422). It is felt that more attention needs to be given to the maximum size of particle. Other devices such as the Casagrande grooving tool and the use of a hand method in determining the liquid limit will be investigated. The use of an equivalent field test will also be checked.

A new section has been formed to study and develop a standard for determining minimum and maximum density of free-draining, cohesionless, granular soils. A symposium on inplace shear testing by the Vane method leading to an ASTM standard method will be developed for presentation at the next Annual Meeting.

The new section on soil conditioners has been organized and plans have been made for activity in this field. A complete review of the "Procedures for Testing Soils" will be accomplished, a special subcommittee having been appointed for this purpose. A standard procedure for determining the bearing ratio of soils has been drafted and will be reviewed further. Other bearing tests are also under consideration.

• **Committee C-11 on Gypsum** is developing a specification for standard sand and an effort will be made to compile data on the effect of shortperiod vibration on plaster.

The committee is considering specifications for accessories in addition to a specification for reinforced precast gypsum roof deck units. Specifications for paper used in gypsum-board products in which weight and thickness as well as fire-hazard rating are factors; and a method of test to evaluate mold resistance treatment of a face paper on gypsum formboard are being developed. A proposed specification for gypsum-wallboard nails is also in process of development.

• **Committee C-12 on Mortars for Unit Masonry** is continuing the study of efflorescence following the publication of a proposed method of test using the efflowick. Difficulties have developed in the running of this test due to the penetration of water through the wick. A research project at the University of California at Los Angeles, dealing with this problem, will be closely followed. The study of off-grade sands is being done in terms of water demands. A roundrobin test series will be undertaken using a standard grading for the sand. The revision of the Tentative Specification for Mortar for Unit

Masonry (C 270) will be considered following research work by Committee C-7 on Lime on the lime types of mortar.

Four laboratories are conducting expansion tests, giving consideration to the effect of the addition of sand on expansion of mortar. The question of the bulking of sand will be studied with a view toward more complete coverage of this property in the specification.

• Perhaps the most comprehensive and long range project of **Committee C-13 on Concrete Pipe** is the development of specifications for heavier reinforced concrete pipe to meet the expanding use of such pipe under higher load conditions. Another project receiving attention is based on the need for uniform procedures for determining absorption as used in the various types of concrete pipe and drain tile. The existing specifications under the jurisdiction of the committee will be subject to further review following suggested revisions on the permissible variations, absence of web-like markings, and a basis of acceptance and location of single circular rings in reinforced pipe.

• A standard procedure for capping clay masonry units with sulfur will be prepared by **Committee C-15 on Manufactured Masonry Units** as a result of a series of tests that have been conducted to compare the effect of mortar, plaster, and sulfur capping on structural clay. The need has been expressed for an ASTM method of testing concrete masonry units for frost resistance, and test procedures will be reviewed for this purpose. The preparation of a separate specification for the class of concrete masonry units having low shrinkage and moisture-volume-change properties has been agreed upon. A study of methods for determining shrinkage will be made initially in order that shrinkage limits can be distinguished. The development of a method for determining moisture content of concrete masonry units by the relative humidity technique has been assigned to a task group.

In exploring the new field of waterproofing materials, the committee will direct its efforts initially toward the preparation of specifications and test methods for coatings of all kinds used above grade.

Drafts of proposed specifications for industrial floor brick and for ceramic tower packings will receive further study before presentation to the committee for action.

• **Committee C-16 on Thermal Insulating Materials** will consider a method of test for distinguishing the different classes of mineral-wool block or board in connection with a specification for mineral-wool block and board insulation for elevated temperatures. Efforts will be made to develop more standard terminology for the several product specifications in this field, particularly for mineral-wool, cellular-glass, and cork pipe coverings.

Plasticity and wet adhesion of insulating cements continue to be subjects for test method development; at least two methods will be reviewed for each property under consideration Proposed specifications for thermal insulating and finishing cements of the mineral wool-hydraulic setting type will be reviewed for possible action at the fall meeting of the committee. The corrosion of steel by insulating cements will receive initial attention during the year.

A specification for mineral-wool-felt insulation (industrial type for elevated temperatures) is expected to be developed as a result of efforts now being made. A draft of a specification for building-insulation blankets is being prepared. A proposed test method for determining the density of loose-fill building insulations by the jolting impact method is expected to be completed by the time of the fall meeting.

Several test methods covering special thermal properties are under development. These methods include a separate test procedure for linear shrinkage of batt, blanket, and loose-fill insulation; a maximum-use-temperature test, for which round-robin evaluation tests are being conducted by insulation manufacturers; and a hot-surface performance test.

In the study of vapor transmission, an investigation of limits of vapor barriers for industrial applications continues; further tests are expected in obtaining data for allowable water pick-up of calcium chloride, and an alternate test method using the water vapor transmission cell developed by Armstrong Cork Co., will be reviewed. Work on physical properties of coatings accessory to thermal insulation will be concentrated on cooperative tests to establish the flame resistance of panels to which coatings have been applied. The new subcommittee on reflective insulation will be concerned initially with definitions of terms relating to reflective insulation, the preparation of a list of reflective materials, classification of various forms preparatory to the development of test methods, and, eventually, specifications.

The research program at Pennsylvania State University continues with plans to conduct further tests using a modified probe; to study means of separating the effect of latent and sensible heat; and final determination of the ability of the probe to measure the conductivity of materials containing small inhomogeneities.

• Handleability of asbestos-cement products continues to be a project of **Committee C-17 on Asbestos-Cement Products** for development of a test method. Also being studied are test methods to determine the amounts of organic materials in asbestos-cement products and to indicate the degree of cure. As a result of a need expressed for a specification for asbestos-cement sewer pipe, a draft is being prepared for consideration.

• Test methods for both core material and the complete sandwich construction continue to be the center of activity of **Committee C-19 on Structural Sandwich Constructions.** Tests of core materials at elevated temperature are presently being studied as well as tests for adhesives. The preparation of a flat-wise flexure test and a peel test represents the current activity of the subcommittee on basic sandwich construction.

Several members of the committee are planning to place test panels at certain of the ASTM test sites as part of an exposure testing program developed by the committee. Fatigue tests for sandwich constructions or for core materials are also included in this program.

• **Committee C-20 on Acoustical Materials** is making final tests for the completion of test data on the reverberation room method for measuring sound absorption. The use of the horn coupler to make possible the testing of 12 in.-square samples on smaller impedance tubes is being investigated as an aid in measuring sound absorption. Several means of measuring flame resistance are still under consideration, a modified form of the apparatus and procedure as found in Federal Specification SS-A-118b being the most advanced. The problem of providing a uniform source of gas and gas consumption is presently being studied.

The two current projects with respect to maintenance are the cleaning and painting characteristics of acoustical materials. There are two phases of the cleaning characteristics: the

ability of the paint film to maintain its adherence to the materials under the abrasive action of a standardized scrubbing test with a brush, and the relative ease with which stains and soils may be removed from the paint surface by washing and scrubbing. A preliminary laboratory study is under way to furnish background for a paintability test method. A study of the soiling of acoustical tile, sponsored by the Public Buildings Administration, is being closely followed by the committee.

In the field of application, activities have been concentrated on the development of an aging test for acoustical adhesives, this test being a necessary part of a proposed specification. Mechanical suspension systems are receiving initial consideration by the committee. Modifications of the Baumgartner Sphere are receiving current attention preparatory to work on a test method based on this apparatus which will be used for evaluation of light reflectance.

• Activity of **Committee C-21 on Ceramic Whiteware and Similar Products** will continue in the two general fields of raw materials and products in the development of test methods. Definite progress is expected in the evaluation of ceramic and electrical properties of barium titanate dielectrics as a result of a round-robin test program now being conducted. Additional test methods on fundamental properties of products under consideration include a method for the numerical evaluation of the translucency of fired ceramic whiteware specimens. A proposed method on thermal expansion, originating in Committee C-8 on Refractories, is being reviewed.

The Research Subcommittee has organized a group to consider modulus of rupture. It is planned to organize additional groups to study methods for determining resistance of overglaze colors to detergents, degree of vitrification (water absorption), and brittleness. The Subcommittee on Nomenclature is studying a number of additional definitions.

• **Committee C-22 on Porcelain Enamel** will pursue several fields of investigation, including evaluation of enameling iron; a survey of the literature on the problem of fishscale; problems of waste disposal and evaluation of clays; evaluation of weathering tests; evaluation of emissivity; and a study of the engineering properties of porcelain enamels. Work will continue on the Tentative Definitions of Terms Relating to Porcelain Enamel (C 286), which is now about one-third completed.

Projects in varying stages of completion include the subjects of tearing, consistency of enamel slip, torsion, coefficient of expansion, and spontaneous chipping and spalling. In the field of finished products the committee is working on test methods for abrasion, enamel thickness, thermal shock, alkali resistance, scratch resistance, continuity of coating, metal marking, color, hot water resistance, mineral acid resistance, bleach resistance, and weather resistance.

• Physical tests for compressed bituminous mixtures continues to be one of the most active projects in **Committee D-4 on Road and Paving Materials.** The need for a standard method of test for stability of bituminous mixtures has been recognized for some time and current consideration is being given to the Marshall test apparatus. Work is also under way on a test method using the Hveem stabilometer and cohesiometer as well as a method of compaction of bituminous specimens by a kneading compactor.

The various extraction methods now being used on bituminous mixtures are being studied with the objective of further refinement. Additional work is required on a method of test for Engler specific viscosity of road tars before definite recommendations can be made. The use of a rolling-ball apparatus as a means of determining the rate of setting of bituminous materials is being investigated. Cooperative tests will be continued to evaluate the durability of bituminous materials by a method known as the "Thin Film Oven Test." The long-established test for penetration of bituminous materials (D 5) is being scrutinized for further refinement to improve its repeatability and reproducibility. In particular, the standardization of a needle-ferrule assembly and the provision of tolerances on total load and test temperature are being considered.

Flame photometry, radioactive tracer elements, and other methods are being studied in connection with the evaluation of the percentage of retained bituminous coating on aggregates. A simplification of the specifications for emulsified asphalt is an objective. A specification for a medium-setting emulsified asphalt is being currently developed.

In respect to aggregates used in bituminous mixtures, a method of test for flat and elongated particles is being studied. Better ways and means of determining the effect of specific gravity of aggregates in bituminous paving mixtures are being reviewed. Specifications and methods of tests for permanent or semi-permanent traffic markers, including reflective materials and excluding paints, is receiving attention.

The preparation of a specification for preformed expansion joint material used in structures is on the agenda of the interested subcommittee. Other associated projects are the proposed specifications for jet fuel resistant joint sealer; the formulation of a test method for extrusion of premolded joint filler under heat; a study of the hydrochloric acid test for cork premolded joint material; and a search for standards of value in determining the ability of material to withstand handling at the site.

• Most of the subcommittees responsible for the various types of roofing and waterproofing materials in **Committee D-8 on Bituminous Waterproofing and Roofing Materials** have active programs of work before them. In the field of prepared roofs and shingles, a task group will review Federal, Underwriters' Laboratories, and ASTM specifications for asphalt shingles for the purpose of coordinating requirements. The development of specifications for mineral surfacing materials for use in built-up roofs is progressing with such characteristics as grading, moisture, dust, light transmission, staining, alkalinity, water absorption, and reaction to freezing and thawing being considered. Both natural and artificially colored materials will be included in the consideration. The use of glass fabrics in the construction of built-up roofs is being investigated.

With respect to bituminous cutback coatings for cold application, additional data are being obtained on consistency of plastic trowelling materials, and round-robin tests will be continued on cold applied roofing materials in this high consistency range.

Four task groups will continue their investigation of rheological properties, considering the adequacy and significance of specific rheological requirements. There is general agreement on the desirability of further elaboration on such general properties as pliability or stiffness, cold flow, adhesion, and heat stability.

• **Committee E-5 on Fire Tests of Materials and Construction** will continue the development of the small scale tunnel test apparatus for measuring flame spread, with further research work at the Forest Products Laboratory being sponsored. Another means of measuring flame spread is the radiant panel test apparatus, which is currently receiving attention in Great Britain and in this country. The committee will closely follow the developmental work of this equipment, particularly at the National Bureau of Standards. Another important need which continues to be a problem to the committee will be emphasized during the year—a method of test for use in defining the term "noncombustible" as applied to building materials.

• Following a critical review of the present status of **Committee E-6 on Methods of Testing Building Constructions** and anticipated activity in the future, the committee plans a period of reorganization during the coming year. There were many indications at the June meeting that an active program of work will be undertaken which will cover many specific problems in the testing of building constructions. Coordination will be needed with many of the existing ASTM technical committees and with outside organizations, especially in the building code field.

ORGANIC MATERIALS, CHEMICALS, PLASTICS

Fast-Growing Industries Demand Greater Standards Effort

• **Committee D-5 on Coal and Coke** has initiated the preparation of a sampling method based upon statistical principles discussed at the Symposium on Coal Sampling in June, 1954. The committee has established an interlaboratory-collaborative-testing program to provide substantial data to support the method prior to its presentation at the next meeting of the International Standards Organization. The method will permit the reduction of the number of samples now required in the Methods of Sampling Coals Classed According to Ash Content (D 492); this reduction in the sampling load will mean substantial saving to the coal industry.

The cooperative investigation of the Arnu dilatometer test program has been reactivated in an effort to provide a laboratory coking or caking test for possible use in conjunction with the Standard Specification for Classification of Coals by Rank (D 388).

A method for determining the weight per cubic foot of coal in storage piles is in process.

The study of the chemical analysis of coal, with the additional coverage of other elements, is continuing.

• Wet bursting strength and mold resistance are two properties of immersed containers now being investigated by **Committee D-6 on Paper and Paper Products.**

Jigs that may be used in apparatus for testing built-up corrugated paperboard are being studied. In general, the committee is working on most of its methods to determine any phases which might be in need of revision.

• The Wood Pole Testing Program continues to be the outstanding activity in **Committee D-7 on Wood.** A report on this research project which is going into its third year appears on page 25. Reports on Southern Pine pole tests, as well as a comparison of the machine *versus* the crib test method will soon be released.

Another important field of needed research is that of durability. In the planning stage is a program of study and testing of the soil-block method for the accelerated testing of wood preservatives and of the natural decay resistance of wood.

Another new field of activity—that of structural fiberboards—will be pursued by a subcommittee recently formed. Under consideration are tests for nail head pull-through, block shear, glue line shear, and falling ball impact. Many needed definitions applicable to fiberboard are also being considered.

One of the basic standards developed by the committee, Tentative Methods for Establishing Structural Grades of Lumber (D 245) has been under review for some time and extensive revisions are in prospect.

• In contrast to the work of many other committees interested in specific materials for a variety of uses, **Committee D-9 on Electrical Insulating Materials** is concerned with a variety of materials for one major use category—that of electrical insulation. Included in the program for the coming year are projects relating to varnishes, plastics, insulating liquids, ceramics, filling compounds, fabrics, papers, and mica as well as the more generally applicable subjects of electrical testing and conditioning.

Results of a round-robin program on a proposed method for "set time" indicates the need for further development. Tests for free film properties of silicone varnishes and heat stability of varnishes are under active development. Viscosity measurements will receive attention through cooperative effort with Committee E-1 on Methods of Testing.

In cooperation with Committee D-20 on Plastics, work is going forward to consolidate two methods for measuring shrinkage from mold dimensions (D 551 and D 955). Revision of the methods for power factor and dielectric constant parallel with laminations (D 669) is an active project. There are new projects to develop methods and specifications for several types of thermoplastic tubing, films, and a glass fiber reinforced laminate bonded with polytetrafluorethylene.

In cooperation with Committee D-2 on Petroleum Products and Lubricants, work is going forward to develop copper corrosion and oxidation tests. The latter tests have included both bomb oxidation and soluble catalyst studies. Other projects are related to neutralization value, sludge tests, metal content, saponification number, sampling, cable impregnants, emulsion tests, oil additives, and power factor tests.

Cooperation is being effected with Committee C-21 on Ceramic Whiteware, etc., in studies of electrical and mechanical properties of titanate and zirconate ceramics used for capacitor dielectrics and piezoelectric materials.

Studies in progress are directed toward development of methods for vinyl coated sleeving, and several forms of plastic and elastomer coated glass fabric tapes. Work on paper includes a method for paper to paper friction, determination of power factor and a proposed specification for capacitor tissue.

The outstanding activity is concerned with problems relating to commingling or blending of specimens of block mica of different grades when assembling standard samples. The problem is complex and much remains to be done.

Active projects are related to measurement of resistivity of solids, particularly as affected by dielectric absorption at constant voltage, dielectric loss of quartz disks at radar frequencies, dielectric strength, power-arc resistance and thermal and corona capability of insulating materials.

• The interest of **Committee D-10 on Shipping Containers** in the field of interior packing has enlarged to include the development of cushioning tests for so-called nonresilient, noncompressible interior packing components. Other areas of interest in this field are being reviewed for possible development of test methods.

Work on revision of the drop test includes collaborative studies on the orientation of the container, construction of the drop surface, load within container, and modification of the dropping device. Continuing work on revision of the vibration test includes study of a series of vibration frequencies, deck weights, and weight locations.

Work on standardizing the revolving drum described in Method of Test for Shipping Containers (D 782) has brought to light differences due to interpretation of the drawings. As a result of the study, new drawings for the revolving drum will be made available in the near future.

The stacking test is undergoing further collaborative study as a result of the first series which revealed considerable variation in test results.

Work on water vapor permeability of immersed containers is approaching completion.

• Studies under way in **Committee D-14 on Adhesives** include an investigation of the possible effects of different rates of loading on shear test results with adhesive-bonded metal lap specimens, development of improved and more widely applicable peel test procedures for adhesive bonds, and development of simple tension, cleavage, and impact test specimens. Effort is being directed toward developing specifications for adhesives in certain packaging applications. Important in these specifications is the development of test methods for solids content, pH, filler content and other analytical and working properties of adhesives. Attention is also being directed toward improved specifications for wood adhesives.

The importance of adequate short-term procedures for reliable estimation of the resistance of adhesive bonds to long-term service under various conditions is recognized and is receiving attention. Nomenclature of terms in the adhesives field continues to receive active consideration. The research subcommittee was reactivated and is considering fundamental problems of tack in adhesives and a continuing survey of important contributions in the literature on adhesion and adhesive bonding.

• Interest in direct-reading antifreeze testers by **Committee D-15 on Engine Antifreezes** has stimulated the investigation of these testers which are now being produced in small quantity. The advantages of direct reading and the convenience of operation are under evaluation.

A new modification of the Karl Fischer moisture determination of concentrated antifreezes has been proposed and is now under consideration as a possible revision of the Method of Test for Water in Concentrated Engine Antifreezes by the Iodine Reagent Method (D 1123).

• **Committee D-16 on Industrial Aromatic Hydrocarbons** has under study methods of testing various properties of naphthalene, pyridine, quinoline, and phenol. Due to the interest in the infrared spectroscopic determination of isomers, development of such a method for nitration grade xylene isomers is under study.

Work has been initiated on the development of temperature-correction tables for benzene, toluene, and the xylenes.

• **Committee D-17 on Naval Stores** is continuing collaborative work on the review of several methods of chemical analysis of rosin taking into consideration recent developments in this field.

Studies in the tall oil field indicate that revisions of the present methods might be desirable to reflect current industrial processes.

Consideration is being given to the standardization of test methods applicable to rosin, such as optical rotation, identification of rosin acid components, and hardness or penetration.

• **Committee D-19 on Industrial Water** is continuing its usual intensive activity in preparation of new and revised methods for testing industrial water and industrial waste water. The following projects are currently under way:

An extensively revised second edition of the Manual on Industrial Water is being prepared and it is hoped that the new edition can be made ready for publication in 1956.

Activities relating to methods of analysis include revisions of the Tentative Methods of Test for Nitrite Ion in Industrial Water (D 1254), and the Tentative Method of Test for Sulfite Ion in Industrial Water (D 1339) to cover low concentrations of sulfite; and of the Tentative Method of Test for Iron in Industrial Water (D 1068). Also under development are new or revised methods of test for volatile amines, copper (gravimetric macro method, carbamate method for medium concentration, referee method for low concentration), zinc, sulfides, nickel, ammonia, and free sulfur. Work on preparation of a comprehensive scheme for analysis of water-formed deposits is being continued. The results of a round-robin test on five methods for the determination of silica are being evaluated and another such round-robin test is being set up.

A new Subcommittee V on Testing Procedures recently established is preparing revisions of the Tentative Method of Test for Electrical Conductivity of Industrial Water (D 1125) and of the Tentative Method of Identification of Types of Microorganisms in Industrial Water (D 1128). Work is under way on development of methods for determination of sodium and potassium by the flame photometer, hydrogen, oxidation-reduction tests, and viscosity sludges.

A subcommittee is studying the application of radioactivity to industrial water testing, and performance tests for ion exchange resins for industrial water treatment are also being developed.

There are in preparation several revisions of the Tentative Method of Test for Oily Matter in Industrial Waste Water (D 1340) and the Tentative Methods of Test for Residual Chlorine in Industrial Water (D 1253). The committee is developing tests for chromium, detergents, oxygen demand, phenolic compounds, determination of specific gravity, evaluation of taste and odor and toxicity to diatoms. Work is continuing on methods for sampling and gaging of industrial water and for the preservation of samples.

In the interest of promoting uniformity of methods for analysis of industrial water within all organizations actively engaged in preparation of such methods, the committee has recommended the participation of the Society in an intersociety committee on uniformity of standard methods for the examination of water, sewage, and industrial waste water.

• Activity of **Committee D-20 on Plastics** reflects the tremendous growth of the plastics industry in recent years as evidenced by the appearance of a bewildering variety of new plastic materials with polysyllabic names. Each of these new materials requires a

specification and the evaluation of some new and different property.

The committee has found that new test methods are needed for determining stiffness of film and for blocking and slip. Several methods for hardness including the Rockwell J and superficial as well as the D-Durometer and Barcol methods are being investigated with a view to characterizing the hardness properties of plastics over a wide range. Several methods for brittleness temperature are also being investigated.

Polyethylene will be the subject of intensive activity both in the improvement of existing specifications and in new test methods to evaluate properties of this versatile material. Properties being investigated with a view to standardizing methods include thermal stability, density, high-shear flow rate, stress cracking, and degree of dispersion of carbon black. Polyethylene is used extensively for plastic pipe, and dimensional standards as well as materials specifications for pipe probably will appear in 1956. Standards for pipe of other plastic materials also are on the docket.

Other items on the program for plastic materials in general include tests for flammability and colorfastness and a recommended practice for outdoor weathering. For corrugated translucent reinforced plastics, test methods for loading of panels, light transmission, flammability, degree of cure and color standardization are in prospect. For the materials going into reinforced plastics, test methods are needed for polyester and epoxy resins, and reinforcing materials including fabrics, rovings, yarns, mats, etc.

In the area of specifications, the following materials will receive attention: polytetrafluorethylene, polychlorotrifluoroethylene, styrene-acrylonitrile polymer, styrene-rubber, polymer rigid polyvinylchloride, octyl phthalate plasticizer (electrical grade), allyl molding compounds, glass fiber filled polyester molding compounds, and glass reinforced epoxy laminates.

• **Committee D-21 on Wax Polishes and Related Materials** is working on development of a ground glass surface for use as a secondary standard with slip resistance testers. Methods for evaluation of dirt retention, spot resistance, and wax application are also being developed.

Other methods under study include those for viscosity, stability, and flash point. The committee is also working on specifications for water emulsion floor waxes.

• A method of assaying the purity of sodium carboxymethylcellulose is under development in **Committee D-23 on Cellulose and Cellulose Derivatives.** Methods for degree of substitution, viscosity, sodium chloride content, sodium glycolate content, and sodium phosphate content are now in preliminary form.

Work on methods of testing cellulose includes cold alkali solubility, nondilution alkali solubility, determination of pentosans, and the ashing of cellulose.

The committee is also considering methods for sampling and analysis of cellulose and its derivatives.

MISCELLANEOUS SUBJECTS

• A proposed recommended practice for ultrasonic testing by the reflection method using pulsed longitudinal waves induced by direct contact, as well as a proposed recommended practice for the resonance method of ultrasonic testing, will probably be published late in 1955 by **Committee E-7 on Non-Destructive Testing**. Work continues on other projects concerning ultrasonic testing including standard reference blocks.

• The Aircraft-Structure Subcommittee of **Committee E-9 on Fatigue** has completed a summary on the status of the spectrum loading problem. At the Annual Meeting considerable discussion on aircraft problems was held, and particularly on the effect of prestressing. It has been shown that by proper degree and direction of prestressing, the life of an aircraft component or structure may be considerably extended.

An analysis of the statistical methods applicable to fatigue data has been prepared by a special task group. This should prove useful in conducting laboratory work.

• Some aspects of tracer applications are being studied by **Committee E-10 on Radioactive Isotopes** with a view toward publication of standards. Subjects such as counting methods, measuring techniques, wear studies, detergency studies, and determination of naphthalene in coal tar are included.

In the field of measurements using external radiation sources, studies on evaluation of carbon-hydrogen gages, evaluation of X-radiation from iron 55 and analysis for sulfur, and back scattering gages are under way.

Department of Defense Makes Progress in Standardization

Considerable progress has been made in the standardization program of the Department of Defense. As indicated in his article (January ASTM Bulletin) "Material Standards in the Department of Defense," Captain C. R. Watts, USN, Staff Director for Standardization, shows that procurement for defense covers a considerably broader area than does the work of ASTM.

One of the important steps in the DOD program is the assignment to specific military departments of responsibility for standards work in specific areas. Such assignments have been made effective March 1955. There follows a list of the assignments of principal interest to ASTM members.

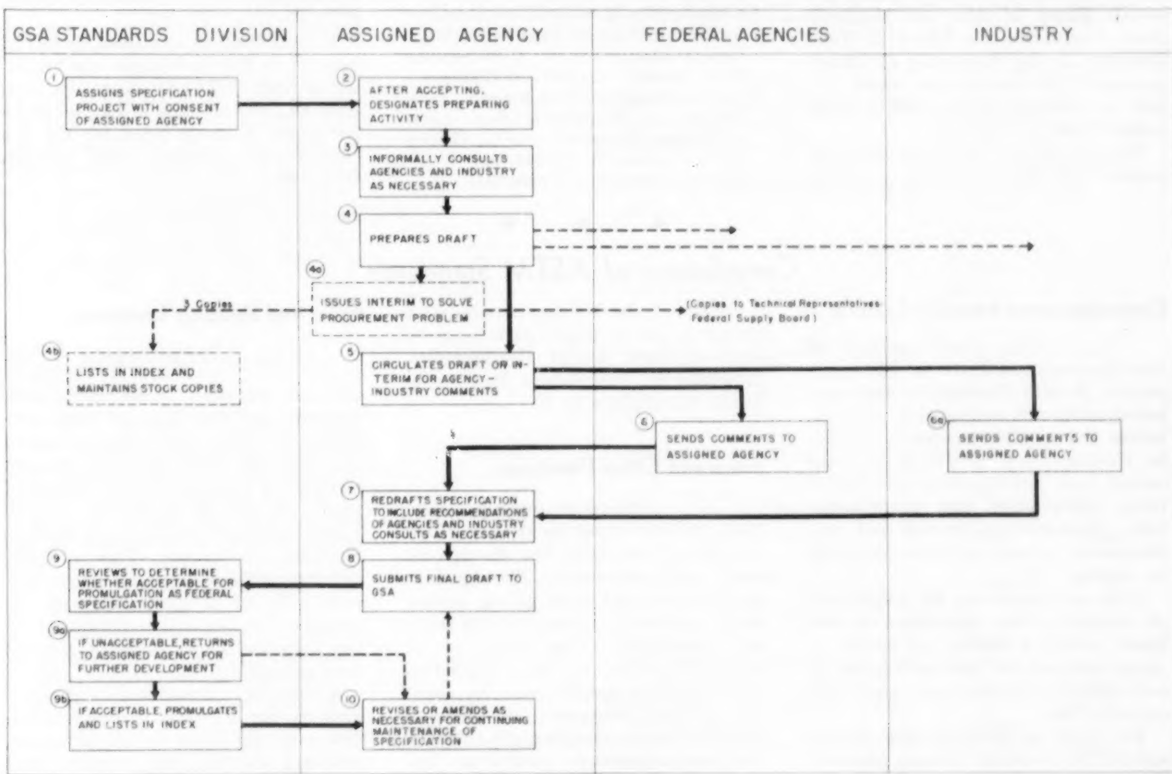
It is the responsibility of the service which has the assignment to organize the activity so that is is coordinated with other departments. It is hoped we may carry in the Bulletin further information on the branches of Army, Navy, and Air which are specifically assigned the various areas or products.

It should be reiterated that ASTM is vitally interested in the DOD standardization activities and is cooperating wherever possible. Both industry and Government have a vital stake in improving our standards, coordinating industry and Government specifications and tests, in the interest not only of economy but of our national defense. A large number of representatives of Army, Navy, and Air Force serve on a host of ASTM committees rendering effective service and at the same time benefiting from their contacts with the industrial and other Government representatives in the work.

Right-of-Way Construction and Maintenance Equipment, Railroad	*Army*
Locomotive and Rail Car Accessories and Components	*Army*
Track Materials, Railroad	*Army*
Tire Rebuilding and Tire Tube Repair Materials	*Army*
Miscellaneous Prefabricated Structures	*Army*
Plywood and Veneer	*Army*
Miscellaneous Plumbing, Heating, and Sanitation Equipment	*Army*
Water Purification Equipment	*Army*
Hose and Tubing, Flexible	*Navy*
Pipe and Tube, Metal	*Air Force*
Fiber Rope, Cordage, and Twine	*Navy*
Mineral Construction Materials, Bulk	*Army*
Building Glass, Tile, Brick, and Block	*Army*

Pipe and Conduit, Nonmetallic	*Army*
Wallboard, Building Paper, and Thermal Insulation Materials	*Army*
Roofing and Siding Materials	*Army*
Miscellaneous Construction Materials	*Army*
Piezoelectric Crystals	*Army*
Electrical Insulators and Insulating Materials	*Navy*
Cable, Cord, and Wire Assemblies, Communication Equipment	*Army*
Miscellaneous Electrical and Electronic Components	*Air Force*
Floor Coverings	*Navy*
Paints, Dopes, Varnishes and Related Products	*Navy*
Preservative and Sealing Compounds	*Army*
Adhesives	*Navy*
Bags and Sacks	*Army*
Drums and Cans	*Army*
Boxes, Cartons, and Crates	*Navy*
Bottles and Jars	*ASMPA*
Packaging and Packing Bulk Materials	*Air Force*
Textile Fabrics	*Army*
Yarn and Thread	*Army*
Padding and Stuffing Materials	*Army*
Leather	*Army*
Fuels, Solid	*Army*
Fuel Gases	*Army*
Gasoline and Jet Fuel	*Air Force*
Fuel Oils	*Navy*
Oils and Greases: Cutting, Lubricating, and Hydraulic	*Army*
Miscellaneous Waxes, Oils, and Fats	*Army*
Paper and Paperboard	*Army*
Rubber Fabricated Materials	*Army*
Plastic Fabricated Materials	*Navy*
Refractories and Fire Surfacing Materials	*Navy*
Fibers, Vegetable, Animal and Synthetic	*Navy*
Wire, Nonelectrical, Iron and Steel	*Navy*
Bars and Rods, Iron and Steel	*Army*
Plate, Sheet, and Strip, Iron and Steel	*Navy*
Structural Shapes, Iron and Steel	*Army*
Wire, Nonelectrical, Nonferrous Base Metal	*Air Force*
Bars and Rods, Nonferrous Base Metals	*Air Force*
Plate, Sheet, Strip, and Foil, Nonferrous Base Metal	*Air Force*
Structural Shapes, Nonferrous Base Metal	*Air Force*
Iron and Steel Primary and Semifinished Products	*Army*

Development of Specifications in General Services Administration



The General Services Administration shows constructive results of its simplification and standardization program under the direction of General Services Administrator, E. F. Mansure. Much simplification and standardization have already been effected. Furniture items have been reduced from 416 to 77; various kinds of administrative supplies from 295 to 54; janitor supplies from 73 to 25. The increased tempo of the Federal Specifications program, through the assigned agency procedure, has brought the total to more than 3500, covering almost $400,000,000 worth of goods. The above chart should be of interest to our members who have contacts with Federal Specifications activities. Capably heading this work is Willis S. MacLeod, reporting through the Commissioner of the Federal Supplies Services, Clifton E. Mack. ASTM contributes to their department's services and stands ready to cooperate with industry and Government requirements and in any other areas where mutual benefits should result.

NEW ASTM PUBLICATIONS

Symposium on Effects of Environments on Strength, Scaling, and Embrittlement of Metals at High Temperatures

Because most high-temperature materials are used in atmospheres which contain water vapor or products of combustion, the design engineer must take into consideration the effects of environment upon the creep rate and ductility of the material he specifies. However, most of the creep and creep-rupture tests from which his design data are obtained are carried out in normal atmospheres.

Realizing that such data on oxidation, surface effects, and creep under controlled conditions did exist and that there was a need to bring them together in one publication, the General Research Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals sponsored this symposium which was held in February during ASTM Committee Week in Cincinnati.

The six papers comprising the symposium have been published as ASTM *STP171* and it is the hope of the panel that their publication will stimulate further work in the field.

Titles and authors of the papers are:

Introduction—Evan A. Davis, Westinghouse Research Laboratories

The Role of Thin Surface Films in the Deformation of Metal Monocrystals—J. J. Gilman, General Electric Research Laboratories

Structure of Oxides Formed on High Temperature Alloys at 1500 F—John F. Radavich, Purdue University

Effect of Strain on the Oxidation of Ni-Cr Heater Alloys—E. A. Gulbransen and K. F. Andrew, Westinghouse Research Laboratories

An Investigation of Intergranular Oxidation in Type 310 Stainless Steels—R. E. Keith General Electric Co., C. A. Siebert and M. J. Sinnott, University of Michigan

The Properties of Oxidation-Resistant Scales Formed on Molybdenum Base Alloys at Elevated Temperatures—M. Gleiser, W. L. Larsen, R. Speiser, and J. W. Spretnak, Ohio State University

Oxidation at Elevated Temperatures—John H. Radavich, Purdue University

Copies of the 120-page symposium can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa. Price: $2.75; to members, $2.

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1954 References on Fatigue

This list of articles published in 1954 dealing with fatigue of structures and materials appears in the same format used for the previous annual lists from 1950 to 1953. References are arranged so that sheets can be cut apart for filing according to any desired plan. Where readily available, abstracts were included.

This publication, sponsored by ASTM Committee E-9 on Fatigue, can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa., for $1.85 per copy. Package price for the five publications covering 1950 through 1954 is $6.

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Compilations of ASTM Standards

Electrodeposited Metallic Coatings

The fourth edition of Specifications and Tests for Electrodeposited Metallic Coatings has been prepared under the sponsorship of Committee B-8 on Electrodeposited Metallic Coatings, the ASTM group concerned with specifications and definitions, performance and conformance tests, electroplating practice and supplementary protective finishes for metallic coatings.

In its work involving the preparation of standards, the committee has followed closely a number of varied research projects and has participated in and sponsored atmospheric and other exposure tests.

The American Electroplaters' Society and ASTM cooperate in many phases of the work on specifications and tests and the AES is officially represented on the committee.

Of the seventeen specifications, methods of tests, and recommended practices included in this compilation eight were approved in their revised forms as standard or tentative in 1955.

Copies of the 100-page compilation bound in heavy paper cover can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $1.85; to members, $1.40.

Soaps and Other Detergents

Since its organization in 1936, ASTM Committee D-12 on Soaps and Other Detergents has, through research and consultation, developed 42 specifications and tests giving quality requirements for various types of soaps and detergents. This work is all brought together in one compilation which includes specifications for soaps and alkaline detergents; methods of test which cover sampling and chemical analysis; and tests for particle size, immersion corrosion, foaming and rinsing properties, acidity, surface tension, etc.

The 1955 edition of the D-12 compilation, 180 pages bound in heavy paper cover, can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $2.50; to members, $1.85.

Paper and Shipping Containers

The various ASTM standard and tentative specifications, test methods, and definitions of terms pertaining to paper and paper products and shipping containers are brought together in a second edition sponsored jointly by ASTM Committee D-6 on Paper and Paper Products and D-10 on Shipping Containers. This compilation represents close cooperation on their part with all interests involved, especially the Technical Association of the Pulp and Paper Industry, through joint committees.

A total of 119 standards and specifications are included in this publication, covering paper specifications, paperboard and shipping container test methods, and shipping container methods and definitions. Appendices include seven proposed methods of test.

Copies of this 404-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $3.75; to members, $2.80.

Report on the Elevated Temperature Properties of Carbon Steel

THIS report is a graphical summary of the elevated-temperature strength data for carbon steels prepared under the auspices of the Data and Publications Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals. It includes summary curves for tensile strength; 0.2 per cent offset yield strength; per cent elongation and reduction of area; stresses for rupture in 100, 1000, 10,000 and 100,000 hr; and stresses for creep rates of 0.0001 and 0.00001 per cent per hr (1 per cent in 10,000 and 100,000 hr).

The primary sources of data for this report were the laboratories engaged in the evaluation of metals for high-temperature service. However, to make the report more complete, data have been taken from trade bulletins and the published technical literature. Data sheets have been prepared from these sources and are included with the data sheets contributed by the cooperating laboratories.

The report is one of a series prepared by this panel. Others have covered the austenitic stainless steels, chromium-molybdenum steels, and selected super-strength alloys; and a report on copper-base alloys is nearing completion.

Copies of this report can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa. Price: $3.75; to members, $2.80.

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1954 Electrical Contacts Supplement

THE size of the 1954 edition of the supplement to the Bibliography and Abstracts on Electrical Contacts indicates a continuing high level of activity in this field. A notable increase appears in the number of publications concerning the relation between circuit and circuit parameters and contact and switching operations.

Prepared under the auspices of ASTM Committee B-4 on Metals for Electronic Heating, Electrical Resistance and Electronic Applications, the compilation of the Supplement has been carried out by a subcommittee consisting of E. I. Shobert II, Stackpole Carbon Co., *chairman;* C. K. Strobel, Robertshaw-Fulton Controls Co.; and F. Spayth, P. R. Mallory & Co.

Copies of the 41-page supplement, *STP 56-I*, can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price; $1.; to members, 75 cents.

Determination of the Shear Stability of Non-Newtonian Liquids

SECTION B on Non-Newtonian Liquids of Research Division VII on Flow Properties, ASTM Committee D-2 on Petroleum Products and Lubricants, in 1952 undertook cooperative work to determine which, if any, of the methods in use at various laboratories were suitable for measuring the shear stability of mineral oils containing high molecular weight polymers.

This report, ASTM *STP182*, prepared by Neal D. Lawson, chairman of Section B, contains the data of this investigation. Among the methods employed by the cooperating laboratories were magnetostrictive oscillators to induce permanent shear breakdowns in the reference oil; sonic oscillators; sharp edge orifices through which oils were pumped under conditions which caused permanent viscosity losses; a diesel fuel injector; a pressure release valve to effect desired shearing action.

The report indicates that any of the various procedures are capable of giving comparable results and that an ASTM test method for determining relative resistance of non-Newtonian liquids to permanent shear breakdown could therefore be written in general terms to permit the use of any type of equipment which could be operated to obtain the desired degree of breakdown with a reference liquid.

Copies can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: 75 cents; to members, 60 cents.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
October 2–6	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C. (Statler Hotel)
October 3–4	Committee C-1 on Cement	Montreal, Quebec (Laurentian Hotel)
October 4–6	Committee B-5 on Copper and Copper Alloys	Philadelphia, Pa. (Society Headquarters)
October 5–6	Committee C-22 on Porcelain Enamel	Pittsburgh, Pa. (Mellon Inst.)
October 6	Committee C-8 on Refractories	Bedford, Pa. (Bedford Springs Hotel)
October 6–7	Committee C-9 on Concrete and Concrete Aggregates	Montreal, Quebec (Laurentian Hotel)
October 6–7	Committee C-19 on Structural Sandwich Constructions	New York, N. Y. (New York University)
October 12	Chicago District—Joint with ASM	Chicago, Ill.
October 13	St. Louis District—Joint with ASM and Engineers Club	St. Louis, Mo. (Engineers Club)
October 18–21	Committee D-13 on Textile Materials	New York, N. Y. (Park Sheraton Hotel)
October 19	Committee C-20 on Acoustical Materials	Chicago, Ill.
October 21	Committee D-15 on Engine Antifreezes	New York, N. Y. (Statler Hotel)
October 24–25	Committee B-1 on Wires for Electrical Conductors	Washington, D. C. (Shoreham Hotel)
October 24–26	Committee C-16 on Thermal Insulating Materials	University Park, Pa. (Nittany Lion Inn)
October 27	Southern California District—Joint with ASM	Los Angeles, Calif.
October 28	Northern California District	San Francisco, Calif.
November 3	Southwest District—Joint with ASM	Dallas, Texas
November 7–9	Committee C-13 on Concrete Pipe	Chicago, Ill. (Union League Club)
November 14–16	Committee D-20 on Plastics	Cincinnati, Ohio (Netherlands Plaza)
November 16–18	Committee D-9 on Electrical Insulating Materials	Cincinnati, Ohio (Netherlands Plaza)

ASTM Bulletin

SEPTEMBER 1955

NO. 208

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Fellow Members and Members of the Staff of the American Society for Testing Materials:

ANOTHER year, as we measure time in ASTM, has passed; our 58th Annual Meeting has become history; and a new year is already under way.

We had an excellent Annual Meeting. Attendance surpassed all other years save our 1952 Fiftieth Anniversary Meeting in New York. Interest ran high. The number of committee meetings held in a single week was almost unbelievable. Our 32 technical and report sessions were packed with reports and papers of inestimable value.

Certainly the Annual Meeting, the report of the Board of Directors, the various old and new activities throughout the year, the worldwide distribution of our publications, speak for the very healthy condition of our Society.

Our Society has grown and progressed during this year in many ways. Membership and especially sustaining memberships have moved upward. Our Staff has increased in experience, and in numbers, and in the many abilities and skills found there. Financially we are in sound state. Our properties and facilities have been improved. Our fields of activities and interests have continued to grow, and the products of our minds and hands have improved our value to the world.

We have drawn excellent men to the Board of Directors and to the positions of responsibility held by our officers.

The future looks very bright.

And the latest addition to the select ranks of Past Presidents desires to thank each and every one of you for the privilege of serving as your President in this significant year of 1954–1955.

NORMAN L. MOCHEL
Retiring President

Year Book To Be Requested Annually

IN a direct communication to each member from President C. H. Fellows, it was announced that the Board of Directors has decided this year to distribute the ASTM Year Book only on request. Each member received a mailing label which he is to fill in and return to ASTM Headquarters if he wishes to have the Year Book sent to him.

Each *new* member of the Society will automatically get a copy of the Year Book the first year but after that, only on request.

The growing size and cost of the book, caused in part by the large increase in the number and size of the technical committees makes it wise in the opinion of the Directors to continue studies of the best means of issuing the Year Book.

The membership list in the Year Book is intended for use in connection with the activities of the Society. Although limited distribution has been made of the book in connection with technical committee work, a decision has been reached to furnish the Year Book to members of ASTM technical committees at a price of $3.50. Thus, those committee members who are not personally affiliated with the Society but who serve on committees as representatives of member companies can now procure it.

Longfellow

OCCASIONALLY, there is some excerpt or note which though not technical, may be of interest to our members and worthy of reading.

In a recent Sunday *New York Times* Book Review Section, J. D. Adams described a visit to the Longfellow House in Portland, Me. He wrote, "I left the house in which he lived and wrote with renewed affection and regard for a writer who rides securely through the passages of time." In an adjoining column was an excerpt from Longfellow's *Defense of Poetry* entitled "A Nation's True Glory":

> We boast of the increase and extent of our physical strength, the sound of populous cities, breaking the silence and solitude of our Western Territories—plantations conquered from the forest, and gardens springing up in the wilderness. Yet the true glory of a nation consists not in the extent of its territory, the pomp of its forests, the majesty of its rivers, the height of its mountains, and the beauty of its sky, but in the extent of its mental power—the majesty of its intellect—the height, and depth, and purity of its moral nature. It consists not in what nature has given to the body, but in what nature and education have given to the mind—not in the world around us, but in the world within us—not in the circumstances of fortune, but in the attributes of the soul—not in the corruptible, transitory, and perishable forms of matter, but in the incorruptible, the permanent, the imperishable mind. True greatness is the greatness of the mind—the true glory of a nation is moral and intellectual pre-eminence.

OFFERS OF PAPERS FOR 1956

THE Administrative Committee on Papers and Publications will meet in early February to consider the papers to be published by the Society in 1956 and to develop the program for the Annual Meeting to be held in Atlantic City, N. J., June 17 to 22.

All those who wish to offer papers for presentation at the meeting and publication by the Society should send these offers to Headquarters *not later than January 10, 1955.* Offer forms are also available to those interested in submitting papers for presentation at the September 1956 Pacific Coast meeting.

All offers should be accompanied by a summary which will make clear the intended scope of the paper and will indicate features of the work that will, in the author's opinion, justify its publication and inclusion in the Annual Meeting program.

Suitable blanks for use in transmitting this information will be sent promptly upon request to Headquarters.

Districts Elect New Councilors

BALLOTING for election of councilors in each of the fourteen ASTM Districts was completed in June. Terms of about one half the councilors expire in June and officers' terms expire in the even number years. The names of all council members, the holdovers as well as those shown below, together with the district council officers appear in the 1955 Year Book which will soon be mailed to those individuals who request a copy (see page 18).

Names of the new or re-elected councilors who will hold office until June, 1956, are listed below. Please note that this is not a complete list of councilors but shows only those newly elected (asterisk), newly appointed, or re-elected this year.

Chicago

Councilors: A. Allen Bates, Portland Cement Assn.; *J. F. Calef, Automatic Electric Co.; H. C. Delzell, Concrete Reinforcing Steel Institute; *T. J. Dolan, University of Illinois; H. J. Gilkey, Iowa State College; *C. H. Jackman, United States Steel Co.; J. E. Lattan, Taylor Forge & Pipe Works; J. O. Osterberg, Northwestern University; E. W. Prentiss, Pennsylvania Railroad Co.; S. R. Wallace, U. S. Pipe & Foundry Co.

Cleveland

Councilors: C. W. Briggs, Steel Founders Society of America; *A. H. DuRose, The Harshaw Chemical Co.; A. H. Feldscher, The Patterson-Sargent Co.; *W. S. Scott, Republic Steel Corp.; T. S. Taylor, Rand Development Corp.; *J. J. Vreeland, Chase Brass & Copper Co., Inc.; *A. E. Weiss, The Superior Die Casting Co.

Detroit

Councilors: *D. M. Bigge, Chrysler Corp.; *Douglas Dow, Detroit Testing Laboratory; *Joseph Fink, City of Detroit, Dept. of Building & Safety Eng.; J. F. Leland, Parker Rust Proof Co.; C. F. Graham, Wyandotte Chemical Corp.; *D. J. McKinnon, Detroit Steel Products Co.; *O. W. McMullan, Bower Roller Bearing Co.; *A. A. Moore, The Dow Chemical Co.; *E. L. Morrison, The Budd Co.; *C. F. Nixon, General Motors Corp.; *C. E. Topping, Consumers Power Co.; *H. Tuttle, Ford Motor Co.; *H. L. Vanderwerp, Peerless Cement Corp.

New England

Councilors: *T. A. Berrigan, Mass. Sewerage Div., Metropolitan Dist. Comm.; *W. D. Clement, University of New Hampshire; *R. H. Doughty, Fitchburg Paper Co.; E. N. Downing, General Electric Co.; Junius Millard, Quartermaster, Research & Development Center; W. M. Murray, Massachusetts Institute of Technology; R. A. Pomfret, Bethlehem Steel Co.; S. H. Sallie, Bird and Son, Inc.; Walter Smith, Arthur D. Little Co.; *H. J. Wollner, American Conditioning House, Inc.

New York

Councilors: A. J. Benline, Building Officials Conference of America, Inc.; *M. B. Chittick, American Mineral Spirits Co.; *C. W. Dorn, J. C. Penney Co., Inc.; *T. S. Fuller, General Electric Co.; *G. R. Gohn, Bell Telephone Labs., Inc.; *Benjamin Grodman, Dept. of Purchase, New York City; *W. T. Gunn, American Petroleum Institute; *W. J. Krefeld, Columbia University; G. H. LeFevre, U. S. Smelting, Refining & Mining Co.; R. W. McNamee, Carbide & Carbon Chem. Div., Union Carbide & Carbon Corp.; *S. Skowronski, International Smelting & Refining Co.; *M. A. Swayze, Lone Star Cement Co.; *R. H. Titley, Public Service Electric and Gas Co.; *Sam Tour, Sam Tour and Co., Inc.

Northern California

Councilors: *T. K. Cleveland, Philadelphia Quartz Co. of Calif.; *R. E. Davis, University of California; *C. H. Fitzwilson, Columbia-Geneva Steel Div., United States Steel Co.; *J. J. Gould, Consulting Structural Engineer; *G. J. Grieve, Pacific Paint & Varnish Co.; Roy Henning, Eitel-McCullough, Inc.; C. F. Lapier, Matson Navigation Co.; *R. A. Kinzie, Santa Cruz Portland Cement Co.; *W. N. Lindblad, Pacific Gas & Electric Co.; *L. Mittelman, Tide Water Associated Oil Co.; *W. W. Moore, Dames & Moore; *G. H. Raitt, Southwest Welding & Mfg. Co.; *R. G. Wadsworth, City & County of San Francisco; *H. A. Williams, Stanford University.

Ohio Valley

Councilors: *D. S. Bruce, The Gummed Products Co.; *R. G. Chollar, National Cash Register Co.; *F. M. Crapo, Indiana Steel & Wire Co.; *B. W. Gonser, Battelle Memorial Institute; *Walter Klayer, Aluminum Industries; *D. E. Krause, Gray Iron Research Institute; *W. R. McIntosh, Civil Eng. Dept., University of Louisville; *E. E. McSweeney, Battelle Memorial Institute; L. E. Squire, Standard Ultramarine & Color Co.

Philadelphia

Councilors: *W. C. Clements, Bethlehem Steel Co.; *D. T. Harroun, Engineering Dept., University of Pennsylvania; *S. S. Kurtz, Jr., Sun Oil Co.; *L. P. Mains, Drexel Institute of Technology; *W. J. McCoy, Lehigh Portland Cement Co.; *J. J. Moran, Kimble Glass Co.; *F. H. Pennell, DeLaval Steam Turbine Co.; N. H. Smith, Franklin Institute; L. R. Walker, U. S. Steel Corp.; J. A. Truitt, American Viscose Corp.; *P. Theel, Philadelphia Textile Institute.

Pittsburgh

Councilors: *F. H. Allison, Jr., Pittsburgh Rolls Div. of Blaw-Knox Co.; *Hugh Beeghly, Jones & Laughlin Steel Co.; B. J. Dennison, Pittsburgh Plate Glass Co.; *F. M. Howell, Aluminum Company of America; *G. H. Knode, Pennsylvania Railroad Co.; *Joseph Marin, Pennsylvania State College; W. C. Mohr, Shanago Pottery Co.; J. J. Rankin, St. Joseph Lead Co.; *H. R. Redington, National Tube Div., U. S. Steel Corp.; G. L. Sommerman, Westinghouse Electric Corp.; *L. W. Vollmer, Gulf Research & Development Co.

St. Louis

Councilors: *E. P. Buxton, Western Cartridge Co., Div. of Olin Industries, Inc.; Delmar Hasenritter, Laclede Gas Co.; *P. G. Herold, Missouri State Mining Experimental Station; *E. W. Kleefisch, Nooter Co.; *N. K. Nason, Monsanto Chemical Co.; *F. V. Reagel, Missouri State Highway Dept.; *E. E. Scholer, Shell Oil Co., Inc.; A. M. Siegel, Industrial Research & Testing Laboratories; R. C. Thumser, Monsanto Chemical Co.; *A. C. Weber, Laclede Steel Co.; *F. G. White, Granite City Steel Co.

Southern California

Councilors: C. H. E. Beck, Gilfillan Brothers, Inc.; G. E. Brandow, Brandow & Johnston; *L. M. Boelter, Engineering Library, University of California, Los Angeles; T. H. Carter, Los Angeles Dept. of Building & Safety; *Guy Corfield, Southern California Gas Co.; *Bert Folda, General Petroleum Corp.; *J. D. Herbert, Blue Diamond Corp.; F. S. Jacobson, Kaiser Steel Corp.; *C. E. P. Jeffreys, Truesdail Labs., Inc.; *Ernst Maag, California State Dept. of Public Works, Div. of Architecture; Louis McDonald, Keylite Products, Inc.; S. S. Oleesky, Reinforced Plastic Consultants & Engineers; *R. E. Paine, Aluminum Co. of America; *P. J. Rich, Kwikset Labs., Inc.; *Leo Schapiro, Douglas Aircraft Co., Inc.; *R. E. Vivian, School of Engineering, Univ. of Southern California; L. L. Whiteneck, Long Beach Harbor Dept.; *D. M. Wilson, School of Engineering, Univ. of Southern California.

Southwest

Councilors: *C. Baumberger, Jr., San Antonio Portland Cement Co.; *R. R. Cahal, Southern Pine Inspection Bureau; *A. B. Campbell, National Assn. of Corrosion Engineers; *James Earthman, Wyatt Metal & Boiler Works; *D. A. Hart, Rainhart Co.; *S. E. Johnsen, Monsanto Chemical Co.; *C. E. Lauer, The Texas Co.; *C. F. Lewis, Cook Heat Treating Co.; *K. E. Luger, K. E. Luger Co.; *M. A. Meyn, Pittsburgh Testing Laboratory; *F. H. Newnam, Jr., Lockwood & Andrews; *H. M. Shilstone, Jr., Shilstone Testing Laboratory; *H. M. Smith, Bureau of Mines; *H. P. Smith, Texas A & M College; *H. D. Wilde, Humble Oil & Refining Co.; *C. S. Wilson, Texas and New Orleans R. R. Co.

Washington, D. C.

Councilors: G. E. Baumgardner, Norfolk & Western Railway Co.; *H. W. Easterly, Concrete Pipe and Products Co., Inc.; J. M. Griffith, The Asphalt Institute; W. P. Poole, Bethlehem Steel Co.; *E. I. Williams, Riverton Lime and Stone Co.; *J. E. Wood, Maryland State Roads Commission.

Western New York-Ontario

Councilors: R. S. Arrandale, Thatcher Glass Mfg. Co., Inc.; E. G. Baker, The Steel Co. of Canada, Ltd.; G. S. Farnham, The International Nickel Co. of Canada, Ltd.; D. L. Garland, Curtiss-Wright Corp.; D. G. Hamme, National Gypsum Co.; J. A. King, Thompson Products, Ltd.; *W. H. Lutz, Pratt & Lambert, Inc.; C. O. Miserentino, Dunlop Tire and Rubber Corp.; R. L. Terrill, Spencer Kellogg and Sons, Inc.; *G. H. von Fuchs, Consultant, Niagara Falls, N. Y.

Sixth Standards Conference Features Government-Industry Cooperation

"Government - Industry Cooperation in Standardization" will be the theme of the Sixth National Conference on Standards, cosponsored by the American Standards Assn. and the National Bureau of Standards, which will be held at the Sheraton-Park Hotel, Washington, D. C., October 24–26, 1955.

The conference program includes sessions on legal implications of standardization; Government-industry standardization at the Office of the Secretary of Defense level and at the Army, Navy, and Air Force level, and Government-industry cooperation in international standardization.

A panel session sponsored by the General Services Administration, the National Institute of Governmental Purchasing, and the Conference of Executives of Organization Members of ASA will discuss "The Relationship of Industry Standards and Specifications to those of Government." Norman L. Mochel, Past-President of ASTM and Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, will represent the Society on the panel. It is appropriate that Mr. Mochel present the discussion for the Society since he continues as chairman of the Board of Directors' Special Committee on Government Contacts.

Roehner and Kaufman Honored by Committee D-2

At the February meeting of ASTM Committee D-2 on Petroleum Products and Lubricants, the following resolutions honoring T. G. Roehner and Gus Kaufman were adopted on recommendation of Technical Committee G on Lubricating Grease:

T. G. Roehner

Whereas Mr. T. G. Roehner played a major role as a charter member in the organization of Technical Committee G, and,

Whereas Mr. T. G. Roehner served faithfully as chairman of Section III of Technical Committee G and gave wise counsel as a member of the Advisory Section of Technical Committee G since its founding, and

Whereas Mr. T. G. Roehner's efforts have been responsible for many of the contributions made by Technical Committee G to Committee D-2 to further the promotion of knowledge of petroleum products and lubricants,

Therefore, Be It Resolved, that Committee D-2 formally recognize Mr. T. G. Roehner's efforts and service in the work of Committee D-2 by appropriate action by officers and members of Committee D-2.

Gus Kaufman

Whereas, Mr. Gus Kaufman played a major role as a charter member in the organization of Technical Committee G, and

Whereas Mr. Gus Kaufman served faithfully as secretary of Technical Committee G and later as vice-chairman of Technical Committee G and gave wise counsel as a member of the Advisory Section of Technical Committee G since its founding, and

Whereas Mr. Gus Kaufman's efforts have been responsible for many of the contributions made by Technical Committee G to Committee D-2 to further the promotion of knowledge of petroleum products and lubricants,

Therefore, Be It Resolved, that Committee D-2 formally recognize Mr. Gus Kaufman's efforts and service in the work of Committee D-2 by appropriate action by officers and members of Committee D-2.

In thanking Committee D-2 for this recognition, Mr. Kaufman wrote:

When I first got to ASTM work, I had just completed some seventeen years in the research laboratory and frankly I had a very hazy idea as to what ASTM was doing and was supposed to do. To be even more frank, my best recollection now is that I thought it was merely a group of people trying to standardize on test methods which would be at best only of little use in my respect.

However, since working in and with ASTM for the past fourteen years, I have come to realize the extreme importance and value of such a group as ASTM. This has been particularly enhanced by the high caliber of personnel which make up its membership and, as importantly, its working groups. It is the one society which permits a proper forum for all groups concerned and not only has national value but international value. ASTM will serve an even more important function in our national life. With the high caliber of people involved in this work, its continued success is assured.

Leather Standards

Over a period of years many inquiries about leather standards have been received at ASTM Headquarters. These inquiries were generally referred to Government standards or the leather trade groups such as the Tanners' Council and to the professional organization of leather chemists—The American Leather Chemists' Assn. The ALCA has sponsored most of the work that has been done on development of standards for leather and a number of standards, mostly test methods, have been published.

There are Government standards for leather which include both test methods and specifications. The Federal Specification KK-L-311a "Leather; Methods of Sampling and Testing" is an example. Methods used are derived largely from the efforts of the ALCA. The Canadian Government also has standards for leather and an example is "Schedule of Physical Testing Methods for Leather" No. 5-GP-O.

A number of large consumers have their own standards for leather. They include the Port of New York Authority and several of the automotive companies (upholstery leathers).

In recent months there have been cordial informal discussions between representatives of ASTM and ALCA on the subject of joint activities on development and publication of leather standards. Though yet in preliminary stages, the governing groups of both organizations look with favor on further consideration of a joint ALCA-ASTM leather standardization activity.

ISO TC 28 Delegation to London

Representing America at the London meetings of the International Standardization Organizations Technical Committee 28 on Petroleum Products and Lubricants on June 23 and 24, were the following:

- E. L. Baldeschwieler, Esso Research and Engineering Co.
- E. S. Brown, California-Texas Oil Co., Ltd.
- H. W. Field, The Atlantic Refining Co.
- W. T. Gunn, American Petroleum Institute
- A. L. Lyman, California Research Corp.
- K. G. Mackenzie, Consultant
- A. E. Miller, Sinclair Refining Co.
- L. C. Burroughs, Shell Oil Co. (*Spokesman*)
- Norman Thompson, Sun Oil Co.

To the Editor

In an article on accelerated fatigue testing, which appeared in Vol. 54 of *Revue de Metallurgie*, pp. 481–489, E. Marcel Prot discussed the theory and advantages of the progressive loading technique. In this method, the load on the fatigue specimen is continuously increased at a constant rate during the test until failure occurs. This process is repeated for a number of loading rates, and failure stress is plotted against the square root of rate of load. Such a plot is found to be a straight line for many materials, and this line can be extrapolated to zero rate of load, which stress should be the endurance limit of the material.

There is no doubt that the progressive loading technique does provide a shorter test and reduce scatter which usually becomes troublesome in the region of the endurance limit in an ordinary fatigue test. Further, brief work in our laboratory indicates that the Prot method does yield a good estimate of the endurance limit of a material. However, Mr. Prot's mathematical basis appeared to disagree with the actual practice, and so a further investigation was attempted in this laboratory.

Mr. Prot's derivation of the straight line equation is based upon the assumption that the Wohler *S-N* curve (stress at failure *versus* number of cycles to failure) is a rectangular hyperbola and that the accelerated fatigue curve, obeying the same rules as the Wohler curve, is also a rectangular hyperbola. If these assumptions hold, Prot's derivation predicts a straight line when stress at failure under accelerated conditions is plotted against the square root of rate of load, $a^{1/2}$. These assumptions raise the question:

Why is a fairly good straight line obtained even though the Wohler curve departs rather widely from a rectangular hyperbola?

A new derivation answers these questions and brings to light an important point.

Assume several fatigue specimens are to be tested in such a way that the load on each is increased at a constant rate during the test but that the rate of loading, a, varies from specimen to specimen. Then, if stress on the specimen is plotted *versus* time (or N if the number of cycles per unit time is constant) a number of straight lines will be obtained, and these lines will terminate at the time of specimen failure (dotted lines, Fig. 1). Now assume that a rectangular hyperbola is obtained if the terminal points are connected by a

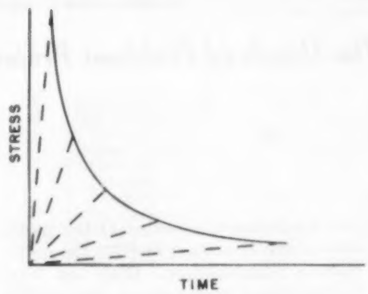

Fig. 1.—Progressive Loading Fatigue Curve.

smooth curve, solid line, Fig. 1. Each terminal point (S, t) then lies on two curves so that

$$S = at \quad \ldots\ldots(1)$$

$$St = K \quad \ldots\ldots(2)$$

where S, t, and a are as indicated above, and K = the hyperbolic constant.

A simple simultaneous solution of Eqs. 2 and 3, eliminating t, results in

$$S = K^{1/2}a^{1/2} \quad \ldots\ldots(3)$$

In practice, it is found that the horizontal asymptote is not zero but some value, E. Then, considering only the stress above E, $S - E$, rather than S, the equations can be modified to yield

$$S - E = K^{1/2}a^{1/2} \quad \ldots\ldots(4)$$

or

$$S = K^{1/2}a^{1/2} + E \quad \ldots\ldots(5)$$

This is the straight line equation for S *versus* $a^{1/2}$ which can be extrapolated to find the endurance limit, E.

The above question is now answered: (1) A straight line can result when the *S-N* curve is not a rectangular hyperbola because the shape of the *S-N* curve is of no importance in the straight line derivation.

Another question is raised, however, and that is, how good a rectangular hyperbola is the solid line of Fig. 1? This can be investigated by checking the linearity of S *versus* $1/t$ from Eq. 2. As probably suspected, such a plot is not linear, but by noting Eqs 2 and 3 it is seen that the slope of S *versus* $1/t$ will be K while the slope of S *versus* $a^{1/2}$ will be $K^{1/2}$. Therefore any departure from a rectangular hyperbola affects the slope of the $S - a^{1/2}$ plot only as the half power of the departure as measured by K. This permits a rather good straight line even when a rectangular hyperbola is not obtained.

It should now be pointed out that the straight-line derivation is no longer tied to the Wohler $S - N$ curve, and the method is not restricted to fatigue testing. It should apply whether the stress is chemical, electrical, or mechanical in nature and whenever the failure point curve (hyperbola, parabola, ellipse, etc.) has an equation which is known and so will allow simultaneous solution with Eq. 2.

A few tests in the General Engineering Laboratory applying the above technique to tensile creep have shown promise. It is hoped that these will be continued and some further work done on dielectric fatigue.

C. J. Guarr
L. S. Lazar

General Engineering Lab.
General Electric Co.

Chemical Compounds Research

The Manufacturing Chemists' Association has started a comprehensive research project on the Properties of Chemical Compounds at the Carnegie Institute of Technology, in Pittsburgh, Pa. The project is planned to serve as a central agency of the chemical industry in collecting, calculating, and compiling basic scientific data relative to the physical and thermodynamic properties of all important chemical compounds of interest and importance to the industry.

In the words of Dr. F. D. Rossini, director of the project, and 1953 ASTM Marburg Lecturer, "such a collection of fundamental data would be to the chemist and chemical engineer what an unabridged dictionary and encyclopedia are to the writer."

In executing the program the industry seeks to obtain fundamental, basic, background information which will benefit the chemical industry as a whole, in fields of broad, but primarily noncompetitive interest, and which will not be directly applicable to any one particular industrial operation or process.

ACR Notes

Administrative Committee on Research

The Unsolved Problems Project

by H. H. Lester[1]

Dr. R. C. Alden, in the April "ACR Notes," presented ideas relative to the ACR "unsolved problems" project that merit serious consideration by the ASTM membership. He points out that the purpose of the project is " . . . to provide research organizations, perhaps chiefly academic researchers, with an appraisal of where research efforts are likely to be fruitful" and expresses the opinion that "the list, 'Some Unsolved Problems', could, if carefully handled, become a kind of national—even international—research and development council devoid of authoritarianism. However, to achieve such stature, far more effort must be put into it." He offers sound suggestions for consideration in making the project more effective and offers the opinion that the " . . . list of 'unsolved problems,' although a good start, falls far short of what could be achieved if the full talent and imagination of the Society's membership could be mustered to the project."

Dr. Alden suggests that the problems may be chiefly stimulative to "academic researchers," while I would impose no such limitation and indeed regard them as of chief value to the engineer or other applied scientist who is more sensitive to the needs of industrial design, although he does not minimize their importance to the stimulation of fundamental research.

There is complete agreement on the need for fuller cooperation by the technical committees in the project. I believe that present low participation is caused by lack of understanding of the objectives rather than by lack of real interest. The chief motivation for the present discussion was the hope that it would promote better understanding and appreciation in the technical committees.

Aspects of Design

A ship, a bridge, or any other structure can render service performance only up to limits set by the properties of the materials of construction. This is an engineering axiom. Design has two fundamental aspects: (1) the geometry of the structure, and (2) the materials of construction. Both are vital to functional performance but ASTM is concerned with the materials aspect.

New design is seldom perfect. The geometry may be at fault, and the materials are almost sure to need improvement. Besides, industrial progress usually encounters situations that were not contemplated in the original concept and that introduce new conditions in the application of the design. Because of these things, problems arise in both aspects of design that may affect seriously the extension of the improved design to new fields of application.

The ACR Project

In 1952 the ACR published a list of "Some Unsolved Problems," the principal objectives of which were to focus attention on areas where there is need for immediate investigative action. The results of the successful accomplishment of these objectives should be to facilitate more efficient and more effective use of research effort.

The unsolved problem of the ACR list is one that is recognized as important. Its importance is determined by the amount of industrial progress it is holding up which usually may be evaluated in terms of the anticipated economic consequences of the solution. It is often one that offers stubborn resistance and which probably has a history of unsuccessful attack.

When concrete highways first came into use, problems arose regarding the durability of the surfacing materials which were acute enough to jeopardize extensive utilization of the advanced design had they not been solved. In such cases, that is where a specific element of industry is affected, urgency may be a large factor in determining importance. In other cases importance is due to very large economic benefits to be expected from a solution. Problems of the latter type often look to the more distant future; are more general in character; affect broad areas of industry rather than specific elements; and quite often involve advanced scientific research. The importance of such problems, judged by the possible ultimate economic consequences of solution, may greatly exceed that of problems where urgency is a strong factor in determining importance.

The 1954 revision of the ACR list contained 67 problems. An analysis of them appears in Tables I and II. Of the 75 technical committees of the Society, only 15 or 20 per cent contributed problems, a fact that would appear to indicate that the Society, as a whole, is not greatly interested in the project. However, the ASTM membership has a well-earned reputation for taking its committee responsibilities seriously. For this reason, the low percentage of participation is regarded as probably due to a lack of understanding of the objectives sought, rather than to a lack of real interest.

The success of the project depends very much on the cooperation of the technical committees. They have the necessary knowledge of the areas in which the problems arise and can judge importances; they propose them for listing; and supply the information used in the preparation of the descriptive text that appears in the published list. In fact, so much responsibility rests with the committees, it would appear that the project should be regarded as a joint enterprise between ACR and the committees rather than as a solely ACR project.

Table II shows that 64 per cent of the problems relate to materials or more specifically to materials properties, and 36 per cent to tests. This greater interest in materials should not be surprising. Progress in the development of very many of the important types of engineering design has reached a point where further advance is impeded due to inadequacies in the materials of construction. Materials of desired properties may not exist; may not be practically available; or usability may await elaborate investigative studies. The preponderance of interest in materials shown in the analysis is partly a reflection of this situation. It may be taken also to indicate the trend of ASTM interest in the immediate future.

The type of research called for was predominantly applied rather than

[1] Consultant, Ordnance Corps, Ordnance Materials Research Office, Watertown Arsenal, Watertown, Mass.

fundamental in the proportion of 61 to 39 per cent. This fact also should not be surprising except that the relative extent of interest in fundamental study is perhaps greater than might have been expected. ASTM is an industrial society and for this reason its technical research inclines toward the applied.

However, applied research depends on fundamental for its basic scientific information. Since the pure scientist is seldom interested in the practical uses to which his results are put, it is inevitable that they tend to be incomplete for the purposes of the engineer and to leave areas where further basic study is required. The "unsolved problems" uncover such areas, and to the extent that they do, they make ASTM interest in fundamental research necessary. It is considered that the surprisingly large extent of interest in fundamental investigations indicated in the analysis is occasioned by this necessity to provide auxiliary scientific information and that such fundamental research should be regarded as secondary to, or perhaps as supporting, the applied effort.

TABLE I.

Designation	Title	Number of Members	Number of Committees	Number of Committees Contributing	Participation,[a] %	Problems per Member[b]
A	Ferrous Metals	510	9	1	11	0.002
B	Non-Ferrous Metals	854	10	2	20	0.010
C	Cementitious Ceramic Concrete, Mortars	353	19	4	21	0.027
D	Miscellaneous Materials	2777	23	6	26	0.007
E	Miscellaneous Subjects	942	14	2	16	0.014
	Totals	6086	75	15	20	0.001

[a] Ratio of the number of committees contributing to the total number within the group.
[b] Number of problems contributed divided by the number representing committee members.

TABLE II.—TECHNICAL COMMITTEES SUBMITTING PROBLEMS AND TYPES OF INTEREST SHOWN.

Committee Designation	Number of Problems						
	Field			Type of Research			
	Materials	Tests or Test Procedures	Total	Applied Research	Fundamental Research	% Applied	% Fundamental
Advisory Committee on Corrosion....	1	...	1	...	1	...	100
B-5.......	1	...		1		...	
B-8.......	7	1	9	7	1	89	11
C-7.......	2	1		2	1		
C-8.......	6	8		4	10		
C-9.......	3	1		4	...		
C-12.......	1	4	26	5	...	58	42
D-2.......	1	...		1	...		
D-4.......	...	1		1	...		
D-6.......	2	3		5	...		
D-7.......	3	2		2	3		
D-8.......	3	2		4	1		
D-9.......	1	...	18	1	...	78	22
E-9.......	11	...					
E-12.......	2	...	13			30	70
Totals	43 64%	24 36%	67	41	26	61	39

Design Invention

There is another aspect of fundamental research that is not secondary to applied; is within the scope of ASTM interest; and is of great significance to the Society, to industry, and to our national strength. This is the use of materials research to produce new materials or materials properties that will inspire design invention.

Inspiration for design may come from the challenge of science. The engineer is stimulated by a desire to make scientific discovery practically useful. Inspiration may also come from the challenge of new or improved materials in which the creative designer is inspired to make useful application of new or improved properties of materials. In this way, the new material becomes the source of the design concept. Through the ages the challenge of materials probably has been more powerful than the direct appeal of science in producing mechanistic invention. ASTM, through its sponsorship of technical investigations, can contribute materials with new and intriguing properties and in so doing contribute toward creative research that serves design invention rather than design implementation.

Creative Research

The analysis of the 67 problems does not bring out the amounts of creative research that may be involved. New materials could be by-products of any basic materials study.

All of the fundamental research called for in the 67 problems was considered to belong in the "supporting" category. Perhaps this is as it should be. Perhaps ASTM should leave creative materials research to the more specialized societies such as American Chemical Society, American Society for Metals, American Institute for Mining and Metallurgy, and others that are doing magnificent work in their respective fields. However, ASTM holds a unique position in American industry and has unique responsibilities to industry because of its association with one of the two fundamental aspects of design, that which concerns materials. No other industrial society has such broad coverage of the materials that go into industrial design and none are more cognizant of the general problems of materials. Also ASTM holds the merited respect of industry and is looked to for advice and guidance in its materials problems. For these reasons, the Society, because of its influential position, is peculiarly fitted to take advanced positions relative to materials problems and could sponsor the cause of creative materials research. It would seem that its responsibility to industry would dictate such a course of action.

Sampling Diesel Locomotive Lubricating Oil for Spectrographic Analysis

A Report from Research Division III on Elemental Analysis, ASTM Committee D-2 on Petroleum Products and Lubricants

The trend in railroad operation from steam to diesel locomotives for power requirements has developed a need for an analytical service which can provide knowledge of diesel engine operating conditions. The lubricating crankcase oils are sampled and analyzed to evaluate those characteristics which cause wear. The resulting information serves for control or record purposes on locomotive operation or it may be the basis for the redesign of equipment.

The determination of wear metals in diesel crankcase oils by established wet-chemical methods is considered impracticable. This is attributable to relatively long elapsed time for completion of an analysis and attendant procedural tediousness. These shortcomings have been largely overcome by use of emission spectrographic techniques. Common to both methods of analysis is the problem of obtaining an aliquot or small portion of the oil as a representative sample. Thus, the sampling technique is a step of utmost importance. The ideal sample has precisely the same composition as that of the crankcase oil from which it is sampled and such an ideal situation cannot be attained except by rigorous control of the sampling technique. This precise control cannot be overemphasized if the interpretation of the collected data is to be meaningful. For a general discussion on sampling techniques, the reader is referred to ASTM Method D 270.[1]

Field Survey of Railroad Practices

Section J of Research Division III on Elemental Analysis has as its assignment the cooperative testing and development of spectrographic analytical methods for the determination of wear metals in used diesel locomotive crankcase oils. The problem of sampling the oil from the locomotive is not considered part of the analytical procedure, itself, but is sufficiently related to the major task to have warranted a status investigation. Therefore, under the auspices of Section J, a field survey has been made of railroad practices for sampling diesel engine lubricating oil for spectrographic maintenance control.

During 1953, approximately 100 railroad test laboratories were questioned, 78 laboratories responded to the questionnaire, and 32 railroads provided detailed information regarding their procedure for collecting samples to be analyzed spectrographically.

An analysis of the survey results indicated that there is considerable lack of uniformity in methods of sampling crankcase oil from diesel locomotives. From the data received, however, it has been possible to derive general principles which have been incorporated in the majority of methods now in use. The reason for publicizing detailed practice is to encourage more precautionary and uniform sampling procedures among test laboratories employing the spectrograph to determine wear metals in lubricants. Consistency in the method of sampling is extremely important to railroads when spectrographic analyses are being correlated with engine condition. Following is a procedure which represents current practice.

RECOMMENDED PROCEDURE FOR SAMPLING LUBRICATING OIL FOR SPECTROGRAPHIC ANALYSIS FROM DIESEL ENGINES IN ELECTRIC LOCOMOTIVE SERVICE

Lubricating oil samples for spectrographic analysis should preferably be taken from engine systems immediately after a period of normal service, with engine idling. Samples may be taken (1) with a sampling gun or (2) from a sampling cock in the lubricating oil line.

(1) When the sampling gun is used, the tube on the gun is inserted through the dip-stick hole in the diesel engine a few inches beneath the surface of the oil. The gun shall be purged by filling and discharging at least twice back into the crankcase. The gun shall then be filled and the sample taken. The sample container shall be clean and shall be filled to only two-thirds of capacity to facilitate thorough mixing prior to analysis.

(2) When the sampling cock is used, it should be located as close to the main circulating pump discharge as possible. The system shall be purged by draining and discarding at least a pint of oil, with sampling valve as wide open as possible. The sample shall then be taken. The container shall be clean and shall be filled to only two-thirds of capacity to facilitate mixing before analysis.

Data as complete as required for proper interpretation of analysis should be obtained, recorded, and securely fastened to the sample container. An adequate time or mileage interval after change of oil or filter should be established to provide a proper correlation of wear metal analyses with engine and oil performance. Minimum data should include:

Railroad
Locomotive number
Locomotive mileage
Locomotive type
Date of sample
Place sampled
Brand of oil
Mileage since last oil change
Mileage since last filter change
Type of filter

F. R. Bryan,
Chairman
Section J on
Spectrographic Analysis of Lubricating

[1] **Tentative Method of Sampling Petroleum Products, 1953 Supplement to 1952 Book of ASTM Standards, Part 5, p. 225.**

ASTM Wood Pole Research Program

—Progress Report No. 3[1]

Since the research on the ASTM wood pole program was started in January of 1954, progress has continued at an active rate. This is the third of a series of special progress reports prepared by the ASTM to keep contributors, committee members, and others interested in the program informed of its progress and status, and of future plans.

Selection of Poles

One very important and complex phase of the program was the identification and selection of the poles for the strength tests. Positive identification with respect to species was essential. For the southern pines which cannot be differentiated as to species from the wood alone, this required selection in the forest where the botanical features could be used for identification. Areas for selection had to be carefully chosen to insure the selection of representative material in locations where facilities for processing were available.

Another phase of the selection of the poles was the all important one of sampling. It was recognized that random sampling to cover the range in density, quality, and strength of poles of each species included in the program would necessitate a very large sample of each, and would involve so many tests of full-size poles that the cost of the program would be excessively great, if not prohibitive. Alternatively, the more practical system of employing the extensive data already available on average density and the frequency distribution of density for different species was employed. Under this procedure the specific gravity of the wood of each pole was determined in the standing tree or in the field from small samples taken with an increment borer. Poles of different densities were then selected in accordance with the established frequency distribution. The method proved to be both inexpensive and effective. Field determinations of specific gravity by means of the increment borer gave results that compared closely with those obtained later by conventional methods, and made it possible to select and test a limited number of poles with the assurance that they were representative of their species. All selections were made by Forest Service personnel and graded by official Western Electric Co. inspectors. It is by such careful attention to details of selection that reliable and impartial test data are being obtained.

[1] A general illustrated report on progress to date was made at the March Chicago meeting of Committee D-7 under whose jurisdiction the work is being conducted. An article on the program was published in the May 1, 1955, Market Issue of *Electric Light and Power* under the title, "Timely Research on Wood Poles Initiated by ASTM."

316 Poles Tested

Tests of full-size poles under both Series I, to afford a comparison of the crib (cantilever) and machine test methods, and Series II, to evaluate the inherent strength of untreated poles of a number of species, have been completed. In all, this involved the testing of some 316 poles of five species, as follows: southern pine (longleaf, shortleaf, slash, loblolly), 109 poles; western larch, 54 poles; Douglas-fir, 45 poles; western red cedar, 54 poles; and lodgepole pine, 54 poles. In order to correlate the inherent quality and strength of the wood with the strength of the poles, tests on small clear specimens were made on material taken from each pole. From the poles tested to date, this has involved some 7000 tests of small, clear specimens to provide data on moisture content, density, bending and compressive strength and stiffness, toughness, and surface hardness. Some tests of small clear specimens from the poles of Series II yet remain to be completed. The computation of results is proceeding. The large number of tests on poles and on the small clear specimens already completed, together with the extensive computing work involved, gives a picture of the magnitude of the program and the substantial accomplishments to date.

An interim report on the tests of untreated larch poles was distributed to all contributors and to committee members some time ago. An interim report on the tests of untreated Douglas-fir poles is being completed and should be available for distribution within a short time. The results of tests to compare the machine test method and the crib (cantilever) test method are being put in report form and should be available in a few months. This will be followed by the report on the southern pine poles. Analysis of data on other species is proceeding as computing progresses and in turn will be included in separate interim reports as rapidly as possible.

It is planned to complete the scheduled research on untreated poles covering Series I and Series II of the program during the present calendar year. The Series III tests to develop the inherent strength of treated poles is planned for 1956. When the several individual interim reports on the different species are completed, the results of all will be integrated into a final report to include the recommendations and conclusions that can be drawn.

Financial Support Encouraging

The ASTM wishes to acknowledge with thanks the support of the program by the large number of organizations whose contributions have been most encouraging and have enabled the substantial progress to date. The program is presently nearing the halfway point, but the collection of material and testing of treated poles has not been started. The committee is continuing to invite further contributions to insure the completion of the entire program as planned, including tests of treated material. A new financial report on the project will be prepared for the next progress report, but a summary of the status of funds as of January 1, 1955, is as follows:

Receipts	
First year contributions (1953) (Including some single contributions)	$ 86,325
Second year contributions (1954)	36,875
Interest credited	145
	$123,345
Expenditures	
First year disbursements, (1954)	$ 85,123
Balance on Hand	
As of January 1, 1955	$ 38,222

The final costs of the complete project are not yet known, but a review of this phase of the program will be undertaken when the current series of reports is completed because current costs are running somewhat above the original estimates. However, it is contemplated that the entire program with the continued support of the contributors will be carried out to completion.

Visitors Welcome

Attention is again called to the standing cordial invitation to visit the Forest Products Laboratory at Madison, Wis., where the research is being conducted, and witness the tests. Because of the fact that testing is not continuous, it is suggested that arrangements for such visits be made in advance.

Graphical Symbols for Electrical Diagrams[1]

EDITOR'S NOTE. This is the story of a successful standardization project on a subject outside the scope of ASTM but of direct interest to it.

With increasing use of electronic apparatus for materials testing, there will be an increasing number of electrical diagrams in ASTM publications. We intend to use the new standard of graphical symbols in these diagrams. Symbols now appearing in the Book of Standards will be made to conform as revisions are made. Authors of papers and committee officers can help by conforming to the new standard. Because most diagrams of interest in testing apparatus are of the low-current rather than the power variety, we will favor the communications symbols where the new standard offers a choice.

GRAPHICAL symbols constitute the oldest form of written language known to man. The ancient caveman drew crude pictures, and as he advanced in his desire and need for written communication he simplified and standardized these pictographs. As this process continued, some of the pictures lost their resemblance to the original objects and became true symbols. Similarly, the scientist started with readily recognizable pictures of the actual pieces of his equipment, and then, to simplify and to let them stand for more than one design, he slowly changed the symbols.

Electrical Symbols

Toward the start of the twentieth century, the economic importance of industrial utilization of electricity attracted many of the workers in the field away from signalling applications that had previously occupied most of them. The paths then taken by heavy-current and by light-current branches of the electrical industry diverged to an astonishing degree, aided and abetted by the curious effects that stem from differences in frequencies employed in the power and communication domains.

This separation was so complete that the graphical symbols used not only were not identical but included direct conflicts among symbols for such fundamental elements as resistance and inductance.

During the Second World War, relatively large new aircraft were produced for the Armed Forces and their size combined with a shift from hydraulic actuators to electric motors for the operation of auxiliary equipment and controls called for rather substantial electric-power installations. This meeting of the power and communication industries in a common project brought sharply into focus the conflicts in graphical symbols.

This situation prompted the wartime emergency development of a coordinated set of symbols by the War Committee on Radio of the American Standards Assn. The use of these symbols was binding only for the duration of the war, and shortly afterward industry began to drift back into its old habits. The war in Korea sparked a resumption of cooperation toward uniform graphical symbols.

A special task group, set up by the Sectional Committee on Graphical Symbols of the American Standards Assn., produced the new American Standard Graphical Symbols for Electrical Diagrams.[2] MIL-STD-15A issued by the armed forces of the United States is fully coordinated with the American Standard.

Compromise

The compromise brought about during the war concerned four basic elements. The objective was to produce a set of symbols in which each symbol had only one meaning. Alternative symbols for a single element would be permitted where a full compromise could not be obtained.

Figure 1 shows the previous symbols and the compromises. It was agreed that the zig-zag symbol would be dropped for power inductance and that it could not be used on power drawings for resistance because of possible confusion. Consequently, both the power and communication symbols for resistance had to be retained as alternatives.

The communication inductance symbol is difficult to draw and the small loops fill in when a drawing is reduced in size. It was agreed, therefore, to dispense with these small loops. A single symbol for inductance was thus possible, although the older (looped) form is still permitted.

It was felt that the communication capacitor and power open contacts were too nearly alike to be used even with strict rules that the capacitor have long lines close together and the contacts be short lines far apart. The power engineers insisted on a very clear distinction

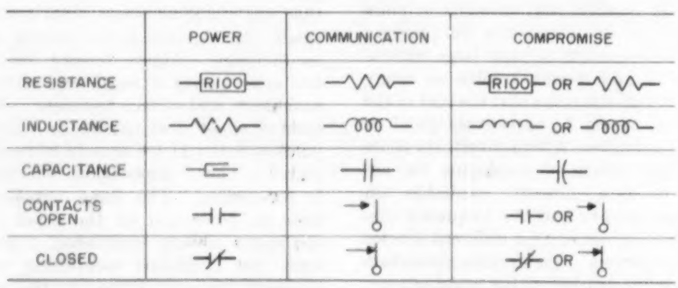

Fig. 3.—Some of the often-used symbols as they appear in the new standard. Where alternative symbols are permitted, the form nearest to that previously used in communication engineering has been given.

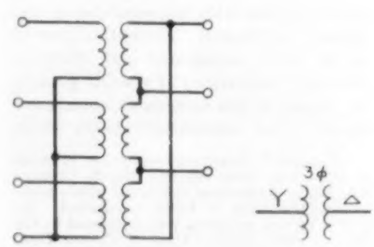

Fig. 2.—Complete A and single-line B drawing of a 3-phase transformer with wye-connected primary and delta-connected secondary. Note that the new standard omits the "hook" where one wire crosses another without making a connection.

[1] This is a condensation of an article by H. P. Westman, in *Electrical Communication*, December 1954; International Telephone & Telegraph Corp., New York; used by permission.

[2] "American Standard Graphical Symbols for Electrical Diagrams, *Y32.2-1954*," issued by the American Standards Assn., 70 E. 45th St., New York 17, N. Y. Published as "IRE Standards on Graphical Symbols for Electrical Diagrams, 1954," by the Institute of Radio Engineers, *Proceedings* IRE, Vol. 42, pp. 965–1020, June, 1954.

between open and closed contacts, better than that provided by the communication symbol. As their symbols cannot be condensed and to permit the large number of contacts that are commonly associated with telephone switching relays, it was necessary to permit both types as alternatives.

Drafting expense and fill-in between closely spaced lines made the power capacitance unsatisfactory. The smallest modification was to curve one of the lines. Although this resulted in an asymmetrical symbol, it was the best single symbol on which a compromise could be obtained.

Types of Drawings

There are three basic kinds of drawings: (1) The type that shows only the major elements of a system. (2) The schematic diagram in which the interconnections among the component parts that make up the system are indicated. This may take either of two forms; a single-line or a complete symbolism. In the power field, a 3-phase system may require three or four wires for transmitting current and separate transformers for each phase. Figure 2 shows how the single-line method simplifies this type of drawing. (3) In the third type, nothing is left to the judgment of the workman, who need have no knowledge of how the equipment is to function or even of what it is to do.

General Rules for Symbols

Once we agree that we are dealing with symbols for functions and not with pictures of specific pieces of equipment, certain general rules may be set up.

Simplicity—To increase the speed and accuracy with which symbols may be drawn and to permit reduction in reproduction, each symbol should be in the simplest form and closely spaced lines or small loops should be avoided.

Orientation and Leads.—The orientation of a symbol must not change its meaning. A ground symbol is still a ground even if it is pointing upward or to the side. While in general it is best to draw symbols in either a vertical or a horizontal plane, this is a matter of orderliness and is given up at times for clarity as in the case of a bridge circuit, which is invariably arranged in a diamond form.

Similarly, leads may be attached to a symbol from any direction without changing the meaning of the symbol as is shown in Fig. 3 for a relay.

International Standards

The International Electrotechnical Commission is in process of revising its standards on graphical symbols. The work already done reflects clearly the contents of the new American standard and we can look forward to a greater degree of coordination in this field throughout the world than ever existed before.

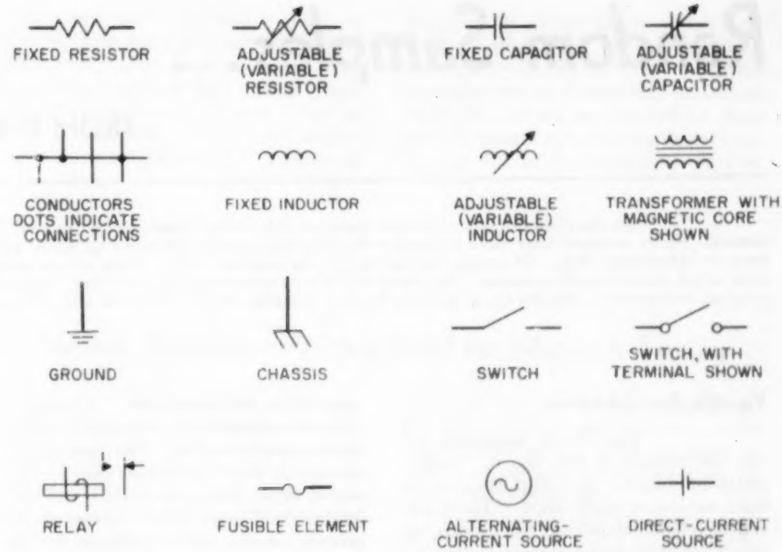

Fig. 1. Conflicts existing in previous practice and the compromise symbols on which agreement was obtained.

Random Samples...

FROM THE CURRENT MATERIALS NEWS

From the broad stream of current materials information flowing from "in-box" to "out-box" in a busy editorial office, random samples (mostly random) have been plucked. Thinking them worth re-showing to ASTM'ers who may have missed the original articles, we have included them here. Of course, we had to trim the samples to fit. There will be those who are not satisfied with samples, especially ones which are not really random. But these ASTM'ers can contact the institution, magazine, governmental agency, etc., who placed the original information in the stream, or address Random Samples, ASTM, 1916 Race St., Philadelphia 3, Pa.

Volatile Rust Inhibitors

THE latest approach to rust prevention is the use of "vapor phase inhibitors," so called because of their method of application. These are organic chemicals which, when released into a confined space, evaporate slowly, depositing the active rust-inhibiting agent on the surfaces to be protected. So far, only a few products in this class are available commercially, but this concept of corrosion control has received increasing acceptance in recent years. Greatest industrial use has been in packaging ferrous metal spare parts.

The Navy's Bureau of Aeronautics recently inspected some obsolete aircraft engines that had been stored on tropical islands in the Pacific as part of a test of the technique of vapor-phase rust inhibition. All the engines had been treated internally with the standard preservative oil, but some were also dusted internally with a small quantity of a slightly volatile white powder, largely composed of amine nitrites. Fully assembled engines were left uncrated and exposed to the elements for two years or until severe internal rusting appeared. In the engines not dusted, this occurred after three months; only treated engines survived the two-year storage without requiring major repairs to become operable.

When there is a microscopic film of inhibitor on an iron or steel surface, the usual corrosive action of the ever-present moisture and oxygen does not occur. The underlying principle appears to be similar to that involved when a "rust preventive" is added to an automobile radiator. In the latter case, it is believed that a thin chemical film forms on the steel surface and regulates its electric potential to prevent the movement of rust-forming ions in the radiator fluid to the metal. Some inhibitors possess the additional characteristic of water repellency.

Many volatile organic substances are known to inhibit corrosion of ferrous metals; some have been patented as vapor-type rust inhibitors. A number of these materials are available as solids, others as semi-solids. For special applications, some inhibitors can be dissolved in oil, water, or alcohol, and still retain sufficient vapor pressure to protect nearby metal surfaces not in contact with the liquid.

The most attractive property of volatile rust inhibitors lies in their ability to reach all exposed surfaces by diffusion through the surrounding atmosphere, thereby generally eliminating the need for mechanical application. Since only thin films are required, small quantities of inhibitor are sufficient, and an item may be put back into service after storage, without special depreservation procedures. The amount of inhibitor actually required for a given degree of protection will vary with the formulation used, the technique of application, and the environmental conditions. For clean, dry, metal surfaces only a very thin film of inhibitor is necessary, but more must be used if moisture or acid is present to any extent.

As long as the film of inhibitor remains intact on the metal surface, it will continue to afford protection. An inhibitor easily deposited by condensation, however, can vaporize just as readily, leaving the surface unprotected. For this reason, the inhibitor vapor must be maintained above a minimum concentration, a requirement not difficult to meet in small confined spaces, such as engine cylinders or packaged equipment. The military stores put into "mothballs" at the end of World War II gave this technique its first large-scale tryout.

Equally important to the discovery of volatile inhibitors has been the development of methods of distributing the inhibitor to all critical surfaces. Wrapping papers impregnated with inhibitor are now available commercially and are suitable for many applications. For internal parts of complex equipment where the paper is not suitable, spraying or dusting may be necessary. An aerosol bomb for inhibitor treatment has recently been marketed. There is a danger in spraying or dusting with some volatile materials, however, if the material should fall onto freshly oiled surfaces this would reduce the vapor pressure and complicate the problem of distributing the inhibitor. A recent advance in technique involves use of chemically active materials that are injected into the system separately and react to form the inhibitor. By providing at least one of the reactants in gaseous form, the reactants will diffuse throughout the system before the inhibitor is formed.

Vapor-phase rust inhibitors are not suitable for some applications involving non-ferrous metals, where they may react with the surface to be treated and produce more corrosion than they were designed to combat. Research on proper use is continuing, however, and it appears that in addition to their importance in corrosion-free storage of ferrous metals, the vapor-phase inhibitors will find other substantial applications.

Industrial Bulletin, Arthur D. Little, Inc., April, 1955

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Carbon Dioxide Shielded Arc Welding

A NEW automatic welding process known as C-OMATIC, which uses low-cost carbon dioxide gas for shielding the arc while welding mild and medium carbon steel, has been developed by the A. O. Smith Corp. of Milwaukee.

Similar in operation to the shielded inert-gas metal-arc process known as "Sigma" or "Aircomatic" welding, the new A. O. Smith development was initiated because commercially available automatic welding heads used with argon or helium gases were limited in application, due mainly to the high cost of shielding gases, particularly on fabrication of carbon steel products.

A. O. Smith Corp. states that the C-OMATIC process offers the advantage of low-cost automatic welding plus the benefit of a visible arc, which enables the welder to locate the arc properly in the welding groove and observe the weld metal being deposited. Their tests have shown that the quantity of carbon dioxide gas required is approximately half of that needed when helium or argon are used. X-ray quality welds can be obtained with the C-OMATIC process, using 30 cu ft (or less) of carbon dioxide per hr, while 60 cu ft of argon, and 70 cu ft of helium are required for the same purpose.

The cleanliness of the weld, a vital factor in plant maintenance, eliminates slag removal and resultant slag entrapment in the weld. Another advantage of the carbon dioxide process is that it eliminates abrasive powdered flux in the area of the welding operation, thus averting another cleanup operation. Finally, deep penetration and high metal deposits form a distinct advantage for single-pass welding as used in the C-OMATIC process.

Snooperscope—A New Non-Destructive Test?

Crystals of General Electric's purest silicon, produced with great effort in the Research Laboratory, were about as transparent as a brick wall—until scientists trained a modified World War II "snooperscope" on them.

Polished silicon has a shiny metallic appearance and looks very much like the stainless steel blade of a table knife. Using the snooperscope, Laboratory scientists have found that they can peer right through a silicon ingot several inches long from one end to the other.

In fact, it seems quite likely that this wartime device, which was first used in nocturnal observations with infrared or "dark" light, will now become a tool in industry. Working with such a device, Dr. William C. Dash, GE Laboratory staff physicist, has found he can study the interior of sections of silicon microscopically in polarized light. In fact, he can spot contaminants, strains, and crystal imperfections directly.

Although visible light will not penetrate silicon, the source is nevertheless an incandescent lamp. Only the infrared or heat radiation passes through the silicon and is changed into visible light by the 'scope, thus disclosing crystal structural information.

A typical use for the 'scope is investigating strains produced when small dots of aluminum, gold, and other metals are alloyed to silicon in manufacturing transistors and rectifiers. With a snooperscope the region around a silicon alloy is seen to be highly strained, with a deeply penetrating "rising sun" pattern, resembling a window struck by an air rifle pellet. The novel instrument has also disclosed the presence of markings in silicon ingots which arise from fluctuations in growth rate. Rendered visible by the industrial snooperscope, such markings and many other phenomena are studied for their possible effects upon the quality of commercial silicon semiconductor devices.

Nuclear Reactors—A New Field for Materials Testing

On April 23, 1955, the AEC invited industry to build and operate with private funds an Engineering Test Reactor (ETR) capable of providing facilities for development of cores, fuel assemblies, and other components of reactor projects for the Armed Services and the civilian nuclear power program. Previously, on April 8, 1955, Westinghouse Electric Corp. had announced the projected building of the first industry-owned nuclear test reactor to provide facilities to test reactor fuel elements and other components of atomic power plants under actual operating conditions.

The irradiation facilities now available to AEC and its contractors are inadequate to handle the current and projected engineering requirements. The present materials testing reactors can accommodate only relatively small samples (largest suitable irradiation space of high neutron density now available is one hole about 5 in. sq at the Materials Testing Reactor in Idaho (see pp. 38 to 40, of the January, 1955 ASTM Bulletin).

The reactor suggested by the AEC would contain eleven test holes ranging from 3 in. sq to 9 in. sq. Seven of the test holes are to extend completely through the reactor, and be completely surrounded by fuel, and the core design is to be flexible enough to accommodate the insertion of specimens as large as 15 in. in diameter.

The Commission will contract with the owner and operator of such a reactor for use of a substantial amount of the irradiation capacity for the first five years of its operation. It would also consider furnishing the required nuclear material free of use charge for the first five years of operation, leasing space for the reactor at the National Reactor Testing Station in Idaho, and process spent fuel elements at charges established by the Commission.

The Atomic Agency expects construction to start not later than October, 1955, and operation at design characteristics to begin not later than March, 1957. Estimated capital costs, if built at the National Reactor Testing Station, are \$10 million to \$15 million (exclusive of fuel costs). Annual costs, exclusive of cost of experiments, would be approximately \$4 to \$5 million.

The Westinghouse Test Reactor will be the first element of a reactor center to be built by Westinghouse, and will cost approximately \$6½ million. This reactor will be built entirely without Government subsidy or guarantee of Government work and is expected to be in full operation within two years. It will operate in the range of 10,000 kw. Westinghouse is asking AEC approval to locate the reactor center at Blairsville, Pa.

Spokesmen for the company say that the main problem of reactor scientists and engineers is development of a fuel material which can withstand tremendous radiation and corrosion inside a reactor which is generating power to propel a ship or produce electricity.

The Westinghouse Test Reactor (WTR) will use enriched uranium as the power source, and water as moderator and coolant. Uranium will be obtained under AEC license.

There are quite a few small privately owned reactors planned, building, or in operation. However, the ETR and the WTR seem to indicate that testing of materials exposed to nuclear radiation has come of age.

WE WILL BUY—

Your Part 1, 1952 Book of ASTM Standards

Since Part 1 of the new 1955 Book of Standards is scheduled to appear in October, some members may be willing to part with their Part 1 of the 1952 Book. If your copy is in reasonable condition for resale, we will buy it back at \$4. Obviously this can apply only in the case of copies available early, so please advise in advance that you are prepared to furnish us your copy.

The Bookshelf

Strength and Resistance of Metals

John M. Lessells, John Wiley & Sons, Inc., New York, N. Y., $10.

THIS book presents the fundamental behavior of metals under stress and the significance of this behavior to the design engineer. The author draws from his own experiences which center around the behavior of steel, the principal material used by engineers. Non-ferrous and other ferrous alloys are mentioned in those particular instances where their behavior differs from that of steel.

In presenting the subject matter, only simple formulae in mechanics are used, although references are made to advanced theory of elasticity and to elements of physical metallurgy. In the book it is pointed out that it is possible for the design engineer to develop more reliable and economical designs by combining the exact solutions of advanced theory and the results from experiments. The student and, particularly, the design engineer will appreciate the manner in which the author has summarized the subject matter and its significance to and use by the designer.

A considerable portion of the book deals with fatigue since the author has found by experience that fatigue accounts for the majority of engineering failures.

To aid students and instructors, illustrative problems are discussed and many additional problems on the subject matter of each chapter are included at the end of the book.

The first three chapters deal with the tension test since it is the most common test used by the engineer to evaluate materials. The first chapter discusses the data derived from the tension (or compression) test and the methods of representing these data, such as, the true stress-strain curve. Presented in chapter 2 is the manner in which the behavior is modified by other factors such as overstrain, temperature, and cold working. The tensile properties at elevated temperature, chapter 3, include the rupture and creep test and the utilization of the data from these tests in engineering design.

The hardness test, chapter 4, covers the significance of the different forms of hardness tests and their importance to the engineer.

In chapter 5 under the title "Impact" the subjects of high strain rates or impulsive loading, types of impact tests, and transition temperature are presented. The difference in the behavior of certain types of engineering structures under high rates of loading is pointed out.

The subject of fatigue is divided into that under normal conditions, chapter 6, and that modified by certain controlling factors, chapter 7. The latter includes the effects of factors such as frequency, temperature, size, shape, surface, mechanical working, environment, and fretting.

Fracture of metals, chapter 8, identifies the causes which initiate failure and covers the tests, examinations, and techniques which aid in this indentification.

Strain hysteresis, chapter 9, and mechanical wear, chapter 10, are treated separately because of their importance in crack formation and propagation and, therefore, in the failure of metals.

The final chapter, 11, reviews the theories of strength and their representation. The choice of a particular strength theory and factors of safety are discussed. Tables of mechanical properties of various metals in common use are included.

This book will be a welcome addition to the library of the advanced student or young engineer because it represents the condensation of many years of experience in the field of strength of materials.

M. J. MANJOINE

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Nickel in Iron and Steel

A. M. Hall, John Wiley & Sons, Inc., New York, 595 pp., $10

THIS book is one of the Alloys of Iron Research Monograph Series, sponsored by the Engineering Foundation. Each monograph is an authoritative and comprehensive review of available information on the effect of selected metals or elements on carbon steels and on simple and complex alloy steels and cast irons. Eleven monographs were published prior to the suspension of activities of Alloys of Iron Research in 1942; this is the second monograph to be published after activities were resumed in 1946.

Nickel in Iron and Steel is a compilation of information and data on the melting, working and fabrication, metallography and heat treatment, physical and engineering properties, and behavior at high, low, and intermediate temperatures, primarily of structural and engineering steels and of nickel cast irons. These steels include the 23xx, 31xx, 33xx, 86xx, and 87xx series They contain up to 6 per cent nickel, alone or together with chromium, molybdenum, manganese, silicon, copper, or vanadium, and account for two thirds of the nickel used in ferrous metallurgy. What the author designates as special-purpose alloys, that is iron-nickel alloys which are valued for their magnetic, electrical, or thermal expansion characteristics, and corrosion and heat-resisting steels and alloys which contain higher nickel contents usually together with chromium, are passed over lightly as they have been discussed in other monographs in the series.

J. G. THOMPSON

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Metallurgy of the Non-Ferrous Metals

W. H. Dennis, Sir Isaac Pitman & Sons, Ltd., London, W.C. 2, 647 pp., $12.50

THE author describes his work as a handbook. In American terminology, it would more probably be called a textbook and a very complete one, covering sources, extractive metallurgy, and refining of the crude nonferrous metals. This volume should find ready acceptance by teachers, students, engineers, and executives who need a test or reference source in its field.

An all-inclusive first chapter treats briefly, but clearly, all of the common fields of metallurgy, from the occurrence of minerals and the various processes used in metals extraction to the physical, mechanical, and chemical properties of metals and the thermodynamic approach to metals extraction. This is followed by chapters describing in detail the apparatus and processes (with flow sheets) used in winning specific metals. The latest and most modern equipment and processes are described. Emphasis is given to American practice in extractive metallurgy because it is more advanced than British practice in most cases. Properties and uses of the metals also are shown.

A list of the chapter headings will indicate the scope of the work but not the author's painstaking effort at securing details of the methods described: Conspectus, Copper, Zinc, Lead, Aluminum, Tin, Nickel, The Ferro-Alloying Metals, Magnesium, Antimony, Arsenic, Cobalt, Cadmium, Mercury, Bismuth, Uranium, Silver, Gold, Metals of the Platinum Group, The Rarer Metals, The Rare Earth Metals, and Radium. Timeliness of the book is indicated by the fact that it not only discusses uranium but also contains a section on atomic energy. Nearly all of the chapters are followed by a useful bibliography.

Appended to the text are tables of conversion factors and tables of physical properties of the elements, and a very handy, condensed table of minerals and their characteristics.

Although relatively few in number for so long a text, the book contains several errata that change the intended meaning. It is to be hoped that these will be corrected in subsequent editions of this timely work.

WEBSTER HODGE

Superfluids

Vol. II, Fritz London, John Wiley & Sons, Inc., New York, 1954, 217 pp.

In work with engineering materials, change of state and change of phase are familiar phenomena often useful in characterizing particular materials. Boiling points and melting points, sharply defined for crystalline or ordered materials but less definite for less ordered or amorphous materials are specific examples of such changes. It has been found that a very good way to learn about the basic physics of materials is to take a simple substance, atomically and molecularly speaking, such as helium and then study its properties over a range of temperature and pressure in which it changes from a gas to a liquid and then to a solid.

For helium, these transitions occur at extremely low temperatures, only a few degrees above absolute zero. Studies of the properties of substances at temperatures near 0 K, or cryogenic studies as they are called, have become increasingly important in recent years as a research frontier for theoretical physics. This book by the late Fritz London covers one important aspect of recent cryogenic studies and though definite provable theories governing the properties of liquid helium were not brought out, the work does point the way for other investigators to unravel the mystery of this strange substance—superfluid helium II.

Many materials, particularly metals, undergo phase changes which are manifested in a break in the specific heat *versus* temperature curve. This is called the λ point. For β-brass, it is about 470 C; for the salt ammonium chloride, it is about 240 K. But for liquid helium (critical temperature 5.2 K), the λ point occurs at 2.19 K. Not only does helium undergo a sharp discontinuity in specific heat at this temperature and below, but some other, very strange, not well understood phenomena occur. At atmospheric pressure, helium remains a liquid down to 0 K. It will only become a solid at pressures above 25 atmospheres. Close to absolute zero, solidification and melting are purely mechanical processes and below 1 K, the entropy is zero even in the liquid condition as indicated by the fact that the melting-pressure curve is nearly horizontal.

It is difficult to imagine zero entropy and the inference of perfect order in a liquid at a temperature above absolute zero. There are actually four very strange or so-called "super" properties of liquid helium II (below the λ point). They are called thermal superconductivity, superfluidity, the fountain effect, and the supersurface film.

The model set up to explain these phenomena on a basis of quantum mechanical treatment is called the two-fluid concept. It is based on the coexistence of two separate systems below the λ point. The two partial fluids are not separated by a boundary in space; rather the two fluids interpenetrate each other.

All these considerations are handled rigorously with much very precise data given. Also there are many references to the work of others. The abstract mathematical and quantum mechanical treatments necessary for work of this kind illustrate the difficulty if not the hopelessness of explaining such complex phenomena with such inadequate symbolism as the English language. Nevertheless, an understanding of the basic properties of materials as illustrated by this work in theoretical physics can be very helpful in guiding the thinking of those who are concerned with the more prosaic problems of engineering materials.

F. Y. S.

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American Standard National Plumbing Code

American Society of Mechanical Engineers, 29 W. 39 St., New York, N. Y., 186 pp., $3.50.

After 20 years of development, a uniform code for plumbing has been designed to modernize existing practices and to coordinate the work of plumbing manufacturers, architects, contractors, and building officials.

Sponsored by The American Society for Mechanical Engineers and the American Public Health Assn., the Code refers to 22 ASTM specifications for materials for plumbing installations such as: clay or concrete sewer pipe; cast-iron soil pipe and water pipe; wrought iron, steel, open-hearth, and brass pipe; malleable iron fittings; and brass fittings.

Although approved as American Standard, the American Standards Association points out that as with all American Standards, it is not mandatory, unless made so by some Code Authority. It is "national" in the sense that it is distinguished from the multiplicity of different codes, which have only local acceptance, and that it is supported by a national consensus. It is intended for municipalities that need it as a basis for setting local standards that are uniform with those used elsewhere.

NEW ASTM BOOKS . . .

are reviewed on page 16

- Symposium on the Basic Effects of Environment on the Strength, Scaling and Embrittlement of Metals
- Shear Stability of Non-Newtonian Liquids
- Bibliography on Electrical Contacts
- Elevated Temperature Properties of Low-Carbon Steel
- Fatigue References
- Soap and Detergent Standards
- Paper and Shipping Container Standards
- Electrodeposited Metallic Coating Standards

Adhesion and Adhesives, Fundamentals and Practice

J. E. Rutzler and R. L. Savage, Eds., John Wiley & Sons, Inc., New York, 229 pp., $9.75.

This bound volume contains 43 papers that were presented at two almost simultaneous conferences on adhesives; one sponsored by the Society of the Chemical Industry, London, England, and the other sponsored by the Case Institute of Technology, Cleveland, Ohio. It was the intent of these conferences to illuminate the present state of theoretical knowledge of adhesion.

This treatise represents the latest and most up-to-date thinking on adhesives and adhesion, and ranks as one of the best publications in this field. It will be of great value to the science of adhesion and the adhesion industry.

ASTM members contributing to this significant collection of papers are: F. W. Reinhart, R. F. Blomquist, Henry Grinsfelder, G. W. Koehn, T. S. Martin, F. Moser, H. A. Perry, Jr., and A. G. H. Dietz.

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The Elements of Chromatography

T. I. Williams, Philosophical Library, New York, N. Y., 90 pp., $3.75.

Early in the 19th century, the German dye-chemist, F. R. Runge, recognized that the ancient dye-drop test of dye workers might have possibilities for inorganic analysis. Subsequent study proved that many inorganic cations in solution can be separated by virtue of the differences in their rate of migration through porous materials by capillary action. Years of devoted work were culminated in 1850 when Runge described his methods, and in 1855 with the publication of "Der Bildungstrieb der Stoffe" in which he used actual paper chromatograms to illustrate his subject.

Work on chromatography continued over the intervening years to include organic compound separation, but it was not until the pressure of the last war that it received its greatest impetus. With the increasing interest in paper chromatography, there came the development of the absorption column permitting analysis of organic and inorganic compounds in both the liquid and gaseous phase.

Today, the possibilities offered by chromatographic methods permit rapid analysis of otherwise difficult materials, and in ASTM there are no less than four of these methods (D 875, D 936, D 1319, and D 1342) which have been standardized.

Anyone wishing to investigate the three major classifications of chromatography in use today, as well as their industrial application and historical background, will find a copy of this copiously illustrated volume most rewarding.

(Continued on page 82)

A Laboratory Method of Test for No-Dirt-Retention Time of Traffic Paints

Supplement to a Progress Report[1] by Subcommittee IV on Traffic Paints of ASTM Committee D-1 on Paints, Varnish, Lacquers and Related Products

By F. H. Baumann[2] and H. H. Diefenderfer[3]

In the previous paper,[1] a method was outlined for testing traffic paints for no-dirt-retention time by using sized road soil.

Sized road soil is a term not specific enough for general use; therefore, additional tests have been made to procure a suitable dirt reagent. Ilmenite and metallic zinc powder were found to be better than various other reagents tried and ilmenite was regarded as superior to the zinc.

Five additional dirt reagents were tried on two types of white traffic paint. The test procedure was the same as previously reported except that the reagents were oven dried at 105 to 110 C and screened through a 420 μ size sieve (U. S. Standard No. 40 Sieve) and the tests were made at a temperature of 72 F and 54 to 56 per cent relative humidity.

In Table I are shown the sieve analyses of the various dirt reagents used. Table II lists the test results. The numerals on the photographs refer to the numbers listed in "Glass Plate No." column shown in Table II.

Conclusion

Ilmenite and metallic zinc powder were found to be better than any of the various other types of reagents; and ilmenite, because of its contrasting color, is regarded as superior to the zinc.

[1] "A Laboratory Method of Test for No-Dirt-Retention Time of Traffic Paints," ASTM Bulletin, No. 176, September 1951, p. 44 (TP 182).

[2] Supervising Engineer, Testing Laboratory, New Jersey State Highway Dept., Trenton, N. J.

[3] Senior Engineer, Laboratory, New Jersey State Highway Dept., Trenton, N. J.

TABLE I.—REAGENTS—NO-DIRT-RETENTION TIME.

Sieve Analysis Passing	Sieve Analysis Retained on	Stone Sand[a]	Ilmenite[b]	Metallic Zinc Powder N. J. Zinc Co. 1205[c]	Graded Ottawa Sand[d]	Bituminous Concrete Sand[e]
...	No. 40....	...	...	...	...	...
No. 40	No. 50....	18.8	0.4	13.8	54.5	29.6
No. 50	No. 80....	20.7	11.2	34.5	35.3	41.8
No. 80	No. 100....	9.2	23.8	16.7	3.4	12.6
No. 100	No. 200....	20.4	64.2	29.4	6.8	13.8
No. 200	...	30.9	0.4	5.6	...	2.2

[a] Kingston Trap Rock Co., Rocky Hill, N. J.
[b] W. G. Vannoy, E. I. du Pont Co.
[c] L. H. Trot, New Jersey Zinc Co.
[d] Ottawa Silica Sand Co., Ottawa, Ill.
[e] Norcross Bros., Birmingham, N. J.

TABLE II.—NO-DIRT-RETENTION TIME OF TRAFFIC PAINTS.

Traffic Paint	Glass Plate	No Pick-up Time	No-Dirt-Retention Time	Reagent	Remarks
New Jersey State Highway Dept. Type I, medium vegetable oil modified alkyd resin in VM & P (no pumice)	No. 4..	30 min	3 hr 15 min	Stone sand	Track clear except for stain
	No. 5..	30 min	6 hr 59 min	Ilmenite	Track clear
	No. 6..	30 min	5 hr 18 min	Metallic zinc powder	Track clear
	No. 7..	21 min	5 hr 47 min	Graded Ottawa sand	End point difficult to see
	No. 8..	20 min	5 hr 14 min	Bituminous concrete sand	A few fine particles in track Stain on track
New Jersey State Highway Dept. Type II, toluol solution of varnish and chlorinated rubber (with pumice)	No. 1..	11 min	33 min	Stone sand	A few fine particles in track at end point Slight stain
	No. 2..	12 min	56 min	Ilmenite	A few fine particles in track at end point
	No. 3..	12 min	53 min	Metallic zinc powder	A clear end point
	No. 9..	10 min	57 min	Graded Ottawa sand	End point difficult to see
	No. 10..	10 min	1 hr 1 min	Bituminous concrete sand	A few fine particles in track at end point Slight stain

Use of the Schlieren Technique to Study Thermal Insulating Properties[1]

By Constantin J. Monego

Studies of the behavior of "still" air layers over the surface of a heated specimen will give added information regarding test runs on the insulating properties of textile materials.

THE insulating properties of fabrics have often been associated with "still" air layers which exist over the surface of the fabric and add to its insulating value. This phenomenon has been recognized early in the 19th century (**3**).[2] One of the early guarded ring hot plates, developed for testing fabrics (**2**), was provided with a hood so that the equipment could be operated in a room without disturbance of the "still" air layer by ambient air currents. Measurements of this air layer were made in the past by indirect methods (**4**). To date the examination of the "still" air has been difficult, since techniques for making this air visible have not been explored by investigators studying the thermal properties of fabrics. The Schlieren technique (**7**), whereby differences of air density can be made visible (**1,5**), suggests the possibilities of photographing the air layer so that it can be accurately measured and its behavior observed in different environmental conditions.

This paper describes a preliminary experiment to demonstrate the feasibility of the application of the Schlieren technique. Further work, using motion pictures and color photographs, gives promise of explaining in greater detail the role of the "still" air layer in the insulation provided by a given fabric or combination of fabrics. A refinement of this technique, to simulate the thermal condition of a human body, should provide much valuable information. In fact, quantitative data regarding the limits of boundary layer, surface temperature, and heat transfer rate are possible. Such data will be useful in designing better cold-weather ensembles by answering questions concerning the relative insulating value of different fibers and the most effective relative positions for rough or smooth surfaces to achieve maximum insulation.

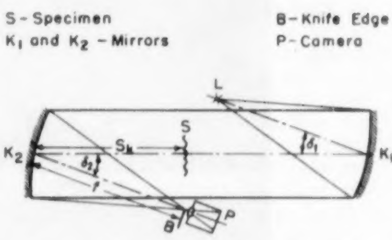

Fig. 1.—Schematic Diagram of Apparatus for Schlieren Photographs (7).

Apparatus and Specimens

The optics of the Schlieren apparatus are shown schematically in Fig. 1. Light is directed from point L to a parabolic concave mirror K_1, from which it is reflected in parallel rays to a similar mirror K_2. This mirror is so slanted as to reflect the beams to a camera, P, at the other side of the mirror system. A knife edge, B, is set at the focal point of the converging rays as they are reflected from the mirror, K_2 to the camera P.

With this system, if the air density in the path of the parallel light is uniform, moving the knife edge, B, into the ray of light would produce a uniform darkening of the mirror surface. The specimen S, which in this investigation consisted of a fabric covering a thermal plate, is positioned between the mirrors. As the heat flowing from the plate changes the air density in the light path, the camera, with the knife edge properly positioned in front of it, photographs the differences in density between the hot air directly along the fabric and the cooler ambient air. The hot air layer appears on the photograph as a darkened area.

Figures 2 (*a*) to (*e*) are photographs of four fabrics taken by the Schlieren technique at the David Taylor Model Basin of the U. S. Navy. A laboratory thermal plate was used. (No special apparatus was designed for the heat source.) The laboratory thermal plate was selected to fit in the space provided for it in the Schlieren system. The temperature of the thermal plate could be controlled at about 250 F. A check of the surface temperature of the plate indicated that the thermostat maintained the temperature between 235 and 260 F. The measurements were made on a hot July afternoon, with the room temperature at 92 F. Thus, the effective temperature differential was about 160 F.

Four fabrics were tested in this exploratory investigation. Two were relatively thin fabrics of approximately equal weight and thickness, but of different fiber content: a rayon tropical suiting, and a tropical worsted. The third was wool frieze, a thick double-faced loop pile fabric, and the fourth was 1.6-oz Fortisan lining fabric. The first two fabrics were tested separately; the third and fourth were tested as an ensemble, duplicating the standard liner formerly used in Army cold-weather clothing. The ensemble was tested in two ways, frieze side up and then Fortisan side up, to determine the effect of the radically different surfaces on the height of the air layer.

C. J. MONEGO, Supervisory Technologist, Quartermaster Research and Development Center, U. S. Army, Natick, Mass., works on thermal transmission and other properties of materials related to the comfort of clothing

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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] This paper also appears in the September, 1955, issue of *The Textile Research Journal* under the title, "Use of the Schlieren Technique to Observe the 'Still' Air Layer Above the Surface of Fabric Covering a Heated Flat Plate."

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

The thermal plate was placed in a 9-in. wind tunnel, which formed an integral part of the Schlieren system used to make the measurements reported here. The gates of the tunnel were shut to provide a closed chamber.

Results and Discussion

Figure 2(*a*) shows the thermal plate at 250 F with no fabric covering. The boundary surface of the "still" air layer is clearly shown here. It extends 0.75 in. above the plate at the high point near the center. The arrow in the photograph indicates the place where the measurement was made.

With the rayon tropical sample on the plate, as shown in Fig. 2(*b*) the dark portion of the photograph, indicating the "still" air layer, measures 0.60 in., a loss in thickness of 0.15 in. Because of its smoothness, the rayon fabric can be considered similar in surface characteristics to the thermal plate itself. It is assumed that, in general, for similar surfaces, the height of the air layer is directly related to the differences in temperature between the exposed surface and the ambient air. The difference between the height of the air layer over the bare plate and that over the rayon tropical fabric, therefore, indicates that the temperature at the surface of the fabric is less than that at the surface of the bare plate, and hence, that the fabric provides some degree of insulation. The less efficient the fabric is as an insulant, the higher the temperature at the fabric-air interface would be, and the thicker the air layer.

In Fig. 2(*c*), the plate was covered with tropical worsted fabric. After the photograph was taken, it was discovered that the fabric was not properly smoothed, and the photograph shows a break in the air layer where the fabric was not flat against the plate. Elsewhere, the air layer is 0.50 in. thick, slightly less than that over the rayon fabric. Further testing would be required to determine whether the difference between the two is significant. The disappearance of the air layer over the part of the sample raised above the plate may be a substantiation of the value of an air space between the body and the fabric.

Figures 2(*d*) and (*e*) show the frieze-Fortisan ensemble. With frieze side up (Fig. 2(*d*)), the air layer measured 0.30 in. With the Fortisan side up (Fig. 2(*e*)), the air-layer thickness was 0.40 in. It should be borne in mind, however, that in the case of the frieze-Fortisan combination, with the frieze side exposed to air, the base line of the fabric is approximately 0.10 in. below the loop height. In the photograph, measurement of the air layer was made from the top of the loop to the outside boundary surface of the air layer. Here it is difficult to determine what constitutes the boundary layer of the fabric, the top of the loop or the top surface of the base fabric that holds the loop in place. The two air-layer thicknesses are approximately alike if the top of the base fabric is taken as a point for measurement. The fact remains, however, that the over-all height of the assembly and air layer is lower when the frieze side is exposed to air than when the Fortisan side is so exposed. That is, that for equivalent assemblies and test conditions, the air layer over a rough surface (such as frieze) is not so thick as the air layer over a smooth surface (such as the Fortisan fabric). It may be that further experiments with the technique will provide a clue to the

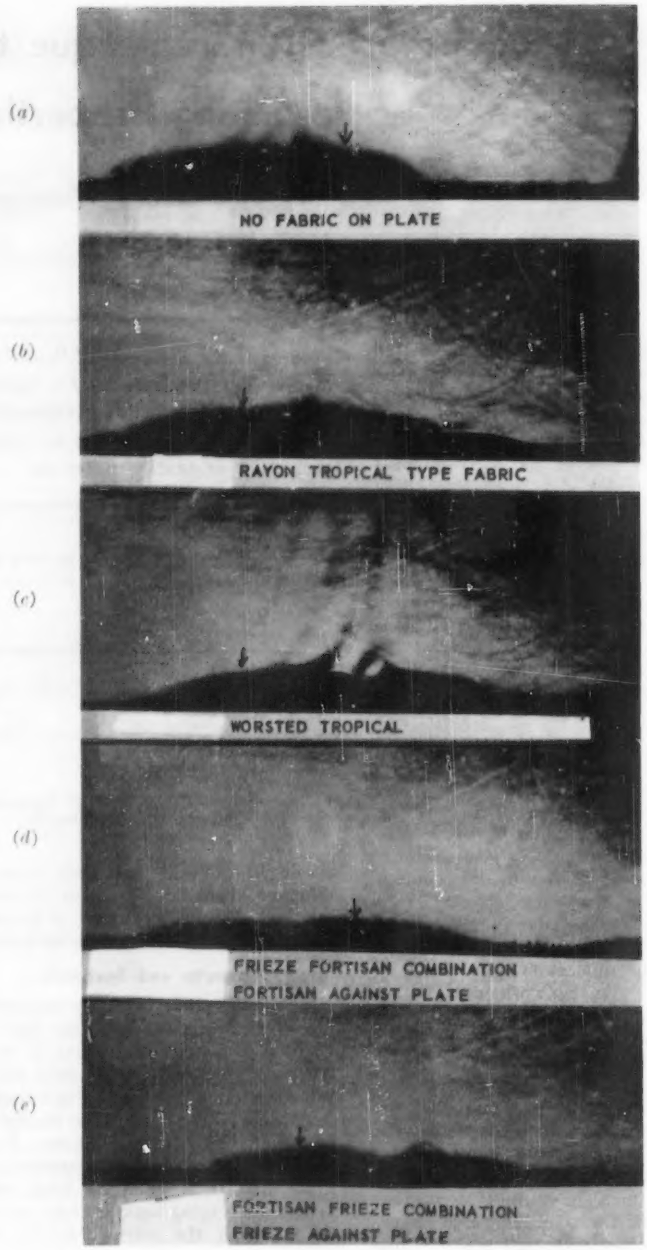

Fig. 2.—Schlieren Photographs of "Still" Air Layers.
Arrows show location of thickness measurements.

TABLE I.—THICKNESS OF "STILL" AIR MASS OVER SURFACE OF HEATED FABRICS.

Sample	Arrangement of Sample	Weight, oz per sq yd	Thickness of fabric, in.		Thickness of Air Layer,[a] in.
			at 0.01 psi	at 0.1 psi	
No fabric	///Hot plate///	...	...	...	0.75
Rayon tropical	///Hot plate///	6.7	...	0.020	0.60
Tropical worsted	///Hot plate///	6.7	...	0.020	0.50
Frieze Fortisan	+ + + + + + + ///Hot plate///	16.0 1.8	0.29 ...	... 0.007	0.30
Fortisan Frieze	+ + + + + + + ///Hot plate///	1.8 16.0	... 0.29	0.007 ...	0.40

[a] Location of measurements shown in Fig. 2.

possible value of napping and other treatments which roughen fabric surfaces for the purpose of improving insulation properties.

The data of this preliminary experiment are summarized in Table I. In all instances, the "still" air layer was seen to build rapidly above the fabric. A slight circulation was noted, which was seen as a constant swirling action along the periphery of the heated layer. This circulating air was seen to rise to the top and center of the layer, where it then trailed off into the chamber atmosphere. A momentary blast, at 30 mph, when jetted across the fabric, lowered the thickness of the air layer to the upper surface of the projecting fibers. When the jet was shut off, the layer rapidly regained its size and shape.

Conclusion

These few experiments have shown that the Schlieren method is well suited for investigating the thermal properties of the "still" air layer. Its applications can be categorized as follows:

1. A study of a "still" air layer around the surface of fabrics and fabric assemblies.

2. A quantitative evaluation of the temperature field defining the limits of the boundary layer, surface temperature, and heat transfer rate.

These two categories for studying air layers offer a wide latitude for investigators working on thermal problems; for example, the study of conditions necessary for entrapping air in cold-weather clothing and dissipating the insulating air layer for hot-weather clothing. The design of garments can also be effectively studied from the standpoint of functional properties. Study can be made on scale models for the optimum design to accommodate subjects when at rest and also at high levels of activity.

Future plans using the Schlieren technique include the following:

1. Refinement of techniques to determine temperature measurements by density measurements on the photographic plate. This will provide quantitative information not only of the boundary layer but also of the heat transfer rate through the system.

2. A study of individual fabrics, fabric layers in contact, and fabric layers artificially spaced at different thicknesses (6) to arrive at an optimum combination of fabric air for good insulation.

3. A pore size study to determine optimum hole size and shape in insulating material for retaining heat at low levels of motion and dissipating heat at higher levels of motion.

4. A study of the effect of air permeability of fabrics on the insulating properties of the garments.

Acknowledgment:

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Abrasive Jet Method for Measuring Abrasion Resistance of Organic Coatings

By A. G. Roberts, W. A. Crouse, and R. S. Pizer

A jet of fine abrasive particles, under closely controlled conditions, is used to abrade through the coating to the substrate—simple, rapid, and reproducible method.

ABRASION resistance is one of the most important properties determining the service performance of a protective coating for military aircraft. Thoroughly reliable measurement of this property in the laboratory is a goal that has not yet been fully achieved. Reliable prediction of service performance by means of laboratory tests would effect a great saving in the time and expense presently involved in selecting protective coating materials capable of withstanding the rigors of service on modern military aircraft. Work toward this end has been conducted in this laboratory as part of the program of the U.S. Department of the Navy, Bureau of Aeronautics, for the development of a high durability, scuff-resistant finish for naval aircraft.

This report describes a new method that has been developed for measuring the abrasion resistance of organic coatings on metals. The method utilizes a jet of fine abrasive particles that, under controlled conditions of flow rate, pressure, distance, and angle, abrades through the coating to the substrate. Compared with other abrasion test procedures in which loose abrasive particles fall[1,2,3,4] rub[5,6], or are blown against[7,8,9,10] the test specimen, the smaller scale of operation of the new Abrasive Jet Method permits greater ease and rapidity in evaluating materials, generally better reproducibility (with the possible exception of the Air Blast Abrasion Tester[10]) through the use of a continuously fresh supply of abrasive particles under closely controllable conditions, greater versatility in readily providing a variety of test conditions, and the use of relatively simpler equipment. The method does not require photoelectric equipment, motors, or drive mechanisms. It is applicable to all types of coatings regardless of gloss, color, or thickness, and it does not depend upon abrading an area of definite size. The method can distinguish significantly between materials difficult to differentiate by qualitative methods. The degree of correlation with actual service performance has not yet been established.

Abrasive Jet Apparatus

The abrasive jet apparatus (Fig. 1) represents an adaptation of the "Airdent" drilling equipment developed by the S. S. White Dental Manufacturing Co. A few basic parts were selected for use in the abrasion test equipment described in this report. These parts include a gas-abrasive mixing chamber, *9*, and vibrator assembly, *10*, a solenoid valve, *7*, a handpiece, *3*, with a swivel to which is attached a right-angle nozzle with a sintered tungsten-carbide tip, *2*, associated sundries such as gaskets, clamps, tubing, and a supply of aluminum hydrate abrasive powder.[11]

The abrasive powder is propelled from the vibrating storage chamber, *9*, by means of carbon dioxide gas under controlled pressure. The amplitude of vibration can be varied by a voltage control unit, *8*. Flow of abrasive powder from the vibrating chamber is cut on or off by a solenoid valve, *7*, operated

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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

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[11] Aluminum hydrate manufactured by Aluminum Company of America as their grade C-31 specially processed.

with a manual on-off switch. The gas-propelled powder is fed to the handpiece, *3*, which is mounted horizontally to a threaded post, *5*, through a sliding bushing in a manner such that either rotational, back-and-forth, or up-and-down adjustments of the handpiece and its accompanying right-angle nozzle may be made. After initial adjustment of the nozzle, *2*, to align it with the axis of the handpiece, the swivel is tightened securely, and subsequent adjustment of the angle between the nozzle tip and the surface to be abraded is accomplished by means of a graduated rotating disk attached to the handpiece shaft, *5*. The specimen to be abraded is firmly clamped to a brass plate, *1*, beneath the nozzle in the manner shown in Fig. 2. The plate itself is mounted on a ball joint (Fig. 1) and equipped with adjusting screws that permit its alignment, if desired, parallel with the plane in which the nozzle moves across the panel, so that a constant nozzle-to-coating distance, as determined with the taper gage, can be maintained while the nozzle swings to different testing locations on the panel. The specimen holder and the entire nozzle assembly with its adjusting parts are housed in a rectangular brass chamber that has a top and front door, *14*, of transparent plastic. The spent abrasive particles and coating debris are removed from the test chamber through a $1\frac{1}{2}$-in. diameter hole in a brass pipe connected to a vacuum exhaust outlet, *4*, at one end of the chamber. The suction hole in the brass pipe is located about 2 in. directly above the specimen mounting plate. Air-inlet holes $\frac{1}{4}$ in. in diameter are bored in the brass housing at strategic locations for minimizing accumulations of spent abrasive particles at convection nodes in the otherwise turbulent test chamber. The spent abrasive is not reused.

A specially calibrated taper gage, *12* (Fig. 2) permits a rapid and accurate adjustment of distance at abrading angles from 20 to 90 deg. Calibration of the taper gage for setting nozzle distance and angle must take into account the geometry of the nozzle; otherwise, large errors may be introduced. The extreme brittleness of the sintered tungsten-carbide nozzle tip made it expedient to grind the hardened tip down flush with its housing. One side of the nozzle was ground flat to give an edge that could readily be set along a given calibration line at the top of the taper gage. The wall thickness and bore of this nozzle end must be taken into account when computing the vertical distance between nozzle edge and coating necessary to give a specified test distance at various angles.

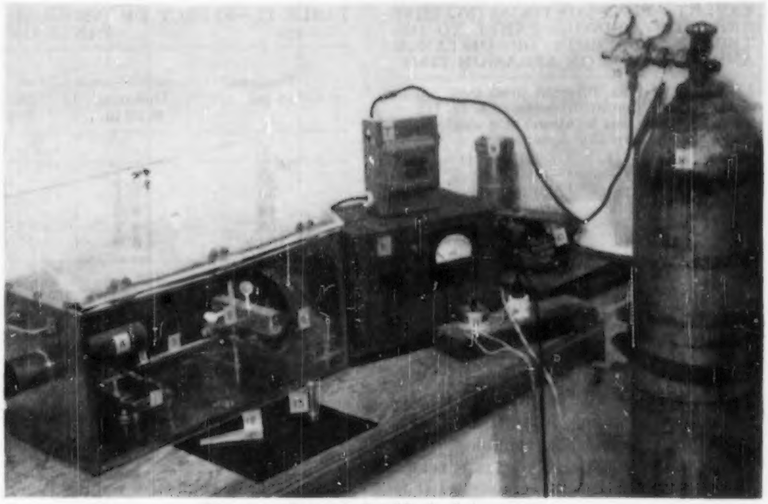

Fig. 1.—Abrasive Jet Method Apparatus.

1—Specimen mounting block
2—Nozzle
3—Handpiece
4—Vacuum exhaust outlet
5—Adjustable handpiece mounting assembly
6—Angle setting gage
7—Solenoid valve
8—Vibrator voltage control unit
9—Gas-abrasive mixing chamber
10—Vibrator unit, spring-mounted
11—Vacuum on-off switch
12—Calibrated taper gage for setting nozzle-to-coating distance at various angles
13—Weighing tube for measuring rate of abrasive flow
14—Transparent plastic front door
15—Pressure control valve
16—Carbon dioxide tank

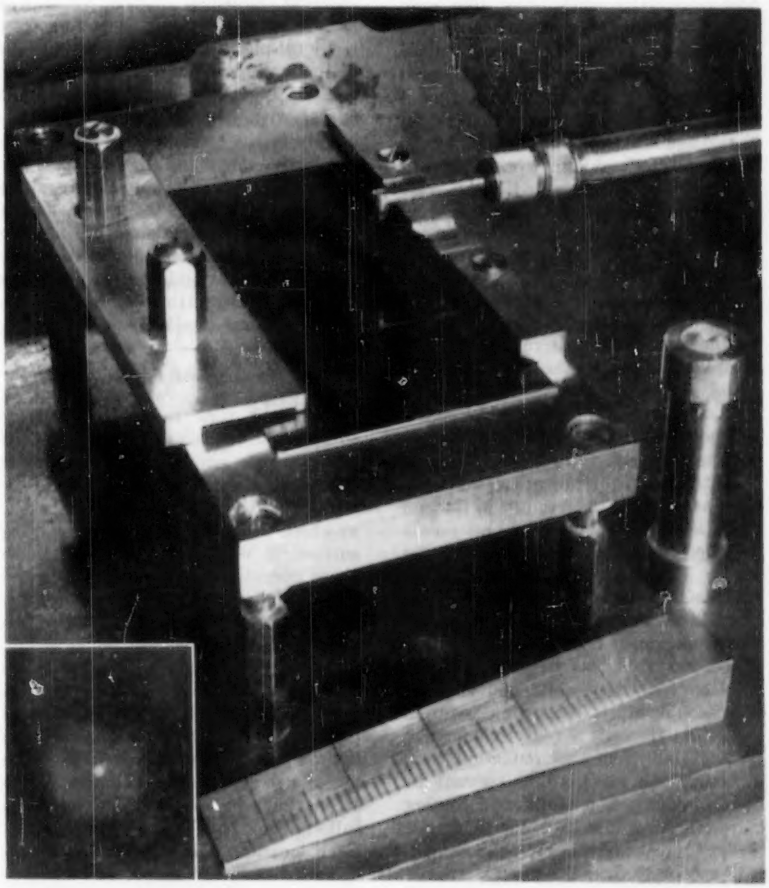

Fig. 2.—Close-up of Mounting Plate, Tested Panel, Taper Gage and Weighing Tube. An enlargement of an abraded area is shown in the lower left-hand corner.

TABLE I.—PLAN FOR LOCATING TEST AREAS OF A SINGLE PANEL TO DETERMINE EFFECTS OF DISTANCE AND PRESSURE ON ABRASION TIME.

1, 2, 3, 4 = four different pressures. a, b, c, d = four different distances. I, II, III = three replicate test locations at a single pressure and distance.

I	II	III	I	II	III
1a	1a	1a	2c	2c	2c
2b	2b	2b	1d	1d	1d
3c	3c	3c	4a	4a	4a
4d	4d	4d	3b	3b	3b
4b	4b	4b	3d	3d	3d
3a	3a	3a	4c	4c	4c
2d	2d	2d	1b	1b	1b
1c	1c	1c	2a	2a	2a

TABLE II.—EFFECT OF PRESSURE AND DISTANCE BETWEEN NOZZLE AND PANEL ON ABRASION TIME.

Pressure psi	Abrasion Time,[a] sec				
	Distance, 0.10 in.	Distance, 0.20 in.	Distance, 0.40 in.	Distance, 0.60 in.	Distance, Avg
		Panel O			
20......	10.4	13.4	27.6	40.8	23.1
30......	7.1	9.3	18.8	39.9	18.8
40......	6.0	7.4	17.6	27.9	14.7
50......	4.2	6.9	14.5	27.3	13.2
Avg.....	6.9	9.3	19.6	34.0	
		Panel E			
20......		...	55.2	...	
30......		...	33.6	...	
40......		8.4	20.7	37.1	

[a] Values reported are the time in seconds required to abrade through the coating to the metal substrate with the abrasive particles striking at vertical incidence. Values for Panel O are the average of three replicate measurements *across* the panel; values for Panel E are the average of paired values *down* the panel (along the thickness gradient).

The gage itself was graduated for perpendicular distance in 0.01 in., with the third decimal estimable. The actual mark to which the gage is set to give a specified distance at angles other than 90 deg is determined by reference to a calibration chart.

Inasmuch as a uniform flow of abrasive is essential for good reproducibility, a device (Fig. 2) was constructed for rapidly determining the weight of abrasive particles flowing from the nozzle per unit time. It consists of an aluminum weighing tube, *13*, approximately $2\frac{1}{2}$ in. long and having an inside diameter of $\frac{3}{4}$ in., with a threaded collar at each end. A rubber diaphragm with a small hole in its center, to accommodate the nozzle tip, is fastened in one end of the tube, and a diaphragm cut from ordinary filter paper is inserted in the other end to permit escape of gas while trapping the abrasive particles.

Measurement of Abrasion Resistance

In measuring the abrasion resistance of a coating material, the time required for the controlled abrasive jet to abrade completely through the coating to the metal substrate is determined. The first show of bare metal is taken as the end point and is readily detected when coating and substrate differ in color. If coating and substrate are so similar in color as to cause uncertainty in the end point, the validity of the end points obtained for a given test panel may be readily ascertained by subsequent inspection of the abraded areas with a hand lens or low-power microscope. The appearance of the abraded areas at the end point may be seen in Fig. 2. Abrasion resistance is conveniently expressed in terms of the time required to abrade through a unit thickness of coating; however, this reduction to a unit thickness basis is not essential for the intercomparison of different coating materials applied at the same thickness.

Since the abraded area is quite small, it is necessary to make replicate measurements in several areas of the test panel to ensure a reliable average value, the number of replicates required being dependent on the variability of the thickness values. In this laboratory, abrasion resistance was evaluated with dip-coated panels, the thicknesses of which were quite uniform except for a slight gradient from top to bottom. The effect of differing thicknesses in different locations of the panel was largely minimized by selecting five test locations in such a manner that four of them were at the corners of a 2-in. square having sides parallel to the panel edges, with a fifth location approximately in the geometric center of both the coated area and the square. An alternative technique is to fix the nozzle and move the panel to bring a line of successive test locations into testing position. This technique saves time and reduces variability by eliminating the need for resetting nozzle distance after each individual test.

Experimental Procedure

Since the time required to abrade through the coating is a function of the gas pressure propelling the abrasive particles, the distance between the nozzle and the specimen, and the angle at which the particles strike the coating surface, it was necessary to establish those operating conditions that would yield good reproducibility before test conditions could be specified. For this purpose a dip-coated test panel of uniform thickness, except for the thickness gradient typical of dipped coatings, was divided into 6 columns and 8 rows to give 48 testing locations, each approximately 9 by 9 mm in area. The use of a single test panel eliminated the error that would otherwise have resulted from panel-to-panel variations. Each location was tested under specified conditions of pressure and distance according to the plan shown in Table I. In this plan, the systematic arrangement of test regions was such as to balance out and largely nullify the effect of the increase in thickness from the top to the bottom of the panel. Since the dip-coating technique does not produce a thickness gradient across the panel, it was feasible to obtain replicate measurements across the test panel. Thus, it was possible to determine the effects of pressure and distance on the abrasion time essentially independently of the testing location. There were not enough test locations in a single panel to permit evaluation of the effect of angle as well as the effects of pressure and distance, while still allowing the desired number of replicate measurements; therefore, vertical incidence was employed for determining the effects of pressure and distance, and another coated panel was used to determine the effect of angle. All the tests were made at a constant temperature and humidity (23 C and 50 per cent relative humidity).

The abrasion tests on the 48-location test panel (Panel O) were made with the nozzle located at distances of 0.10, 0.20, 0.40, and 0.60 in. from the surface of the coating. At each distance the effect of gas pressures of 20, 30, 40, and 50 psi (measured at the cylinder outlet) on the abrasion time was determined. The data are given in Table II, and the average values are plotted as the Panel-O curves in Figs. 3 and 4. A second series of abrasion tests at various distances and pressures was made on another panel (Panel E). These data are given in Table II and are plotted as the Panel-E curves in Figs. 3 and 4. To the extent possible while maintaining a practical testing time and pressure, operating values upon which to standardize were selected from the regions of smallest slope on these time-distance-pressure curves. A distance of 0.40 in. and a pressure of 40 psi were thus chosen as standard test conditions.

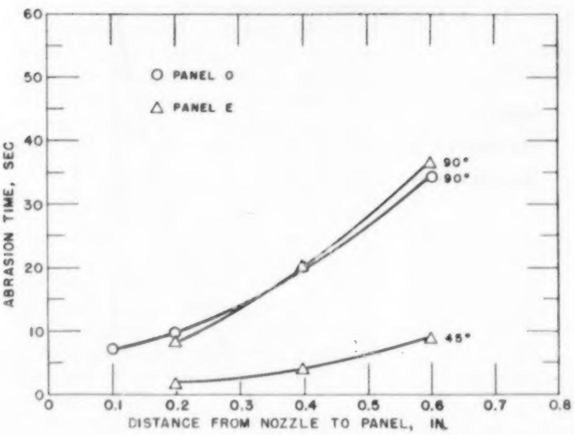

Fig. 3.—Effect of Distance on Abrasion Time.

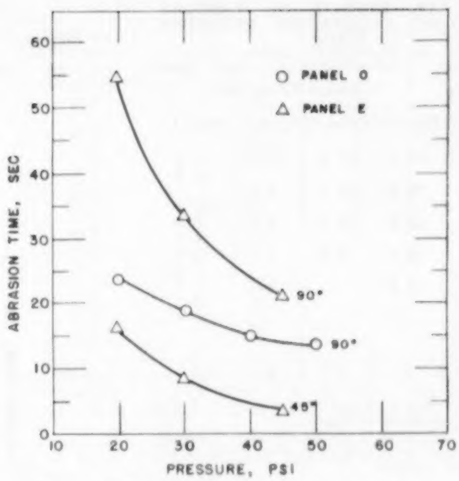

Fig. 4.—Effect of Pressure on Abrasion Time.

Effect of Nozzle-to-Coating Distance and Gas Pressure

From the data in Table II and in Figs. 3 and 4, it is seen that the abrasion time for a particular coating system depends strongly on the nozzle-to-coating distance and on the gas pressure employed. The increase in abrasion time with increasing distance is nearly linear over the range investigated and is associated with a nearly linear increase in the diameter of the over-all abraded area. The decreasing severity of the abrading action as distance increases is largely caused by the spreading of the abrasive stream as it gets further from the nozzle. The decrease in abrasion time with increasing pressure becomes progressively less pronounced as the pressure increases, at least partly because of the greater frictional resistance that the abrasive particles encounter in traveling through the tubing and nozzle as their speed increases.

Effect of Angle of Abrasion

The angle of abrasion also strongly affects the severity of the abrading action. The data in Table III indicate that the abrading action at an angle of 45 deg is about three times faster than that at vertical incidence. The difference in abrasion time between abrading angles of 90 and 45 deg at different pressures and distances is illustrated by the data for Panel E which is plotted in Figs. 3 and 4.

Close inspection of the data in Table III reveals that although the abrasion rate is much faster at 45 deg than at 90 deg, the various coating materials tend to fall into the same sequence with respect to their abrasion resistance regardless of which angle is used as the criterion. However, it is possible that the angle of abrasion may be a critical factor in comparing materials differing widely in physical properties.

Since the nature of the abrading action would be expected to differ with the angle of attack, it is quite possible that different abrading angles may give different correlations with actual service performance. Abrasive particles striking normal to the coating surface would tend to compress, scar, and cut into the coating so that particles of the coating would ultimately be undercut and displaced. Abrasive particles striking the surface at nearly grazing incidence would tend to shear through minutely thin layers of the coating in successive slices and would eventually wear it away. Between these two extremes, the abrading action would be a combination of the two types described, depending on the abrading angle, with the two types of action perhaps approaching equal importance at an incidence of about 45 deg. It seems reasonable to postulate, therefore, that the 90-deg test tends to simulate the leading-edge type of erosion encountered by aircraft in flight, while the 45-deg test more nearly simulates the scuffing type of wear which aircraft receive during maintenance operations when they are likely to be walked upon, or struck or scraped by hose nozzles.

Verification of this hypothesis must necessarily wait until the performance of laboratory-evaluated materials can be tested in actual service. With respect to this, flight tests, with experimental scuff-resistant coatings, being conducted by the Bureau of Aeronautics should provide highly useful correlative information. Meanwhile, it is the practice in this laboratory to evaluate all coating materials at abrading angles

TABLE III.—EFFECT OF ABRADING ANGLES OF 90 AND 45 DEG ON ABRASION TIME.

Panel[a] Designation	Number of Replicates[b]	Distance, in.	Pressure, psi	Abrasion Time, sec: 90 deg	Abrasion Time, sec: 45 deg	Ratio, 45 to 90 deg
A	8	3/8	40	10.4	4.5	0.43
X4-2	10	3/8	40	31.5	10.5	0.33
X4-7	5	3/8	40	37.9	14.5	0.38
X4-8	5	3/8	40	28.1	9.3	0.33
X5-1	5	3/8	40	3.9	2.9	0.74
X5-2	5	3/8	40	4.3	2.2	0.51
X6-1	5	3/8	40	44.1	28.7	0.57
B	6	3/8	40	39.5	18.6	0.47
C	4	3/8	40	27.5	9.5	0.35
D	6	3/8	40	14.0	4.7	0.34
E	2[c]	0.40	20	55.2	16.5	0.30
	2[c]	0.40	30	33.6	8.7	0.26
	2[c]	0.40	45	21.4	3.9	0.18
	2[c]	0.20	40	8.4	1.9	0.23
	2[c]	0.40	40	20.7	4.2	0.20
	2[c]	0.60	40	37.1	8.8	0.24
F	2[c]	0.40	40	21.7	4.0	0.18

[a] Panels A to F all have the same type coating; the X series of panels differ among themselves with respect to type of coating.
[b] Number of tests averaged to give the value reported.
[c] Paired values at locations selected to offset thickness gradient.

TABLE IV.—EFFECT OF VARIOUS ABRADING ANGLES ON ABRASION TIME.

Abrading Angle, deg	Abrasion Time,[a] sec			
	Panel B	Panel C	Panel D	Panel F[b]
90...	39.5	27.5	14.0	21.7
80...	...	...	...	14.5
75...	28.7	21.1	9.2	...
70...	...	...	...	12.9
60...	23.4	14.4	5.3	7.3
50...	...	...	...	4.7
45...	18.6	9.5	4.7	4.0
40...	...	...	...	3.6
30...	11.2	...	2.1	2.8
20...	...	...	...	3.3
Number of replicates.	6	4	6	2

[a] Tests made at a nozzle distance of 0.4 in. and a pressure of 40 psi.
[b] Values reported are the average of paired values from test locations selected to offset thickness gradient.

TABLE V.—EFFECT OF PRESSURE ON ABRASIVE FLOW RATE.

Pressure, psi	Abrasive Flow Rate, g per 15 sec	
20	1.10, 1.23, 1.41, 1.27	Avg = 1.25 ± 0.13[a]
30	1.27, 1.22, 1.15, 1.31	Avg = 1.24 ± 0.07
40	1.40, 1.37, 1.18, 1.30	Avg = 1.31 ± 0.10
45	1.39, 1.51, 1.22, 1.41	Avg = 1.38 ± 0.12

[a] Standard deviation.

of both 90 and 45 deg and to regard as most promising those materials which show superior abrasion resistance at both angles.

It is interesting to note how the abrasion time varies over a wide range of abrading angles as typified by the data in Table IV and the graph in Fig. 5. The fall-off in abrasion time with decreasing angle of attack becomes progressively less pronounced from 90 down to about 30 deg. At lesser angles the abrasion time again begins to increase, although the character of the curve below 20 deg could not be determined because of the difficulty in setting the angle and distance in this range.

Flow Rate of Abrasive

The data in Table V, showing the effect of gas pressure on the abrasive flow rate, were quite surprising. Contrary to expectations, the quantity of abrasive leaving the nozzle per unit time depended only slightly on pressure within the range examined. From the experimental point of view, this is a desirable circumstance because it indicates that the variations in abrasive flow rate encountered during testing are not so serious as was originally thought. Evidently the increase in the severity of the abrading action with increasing pressure is due mainly to an increase in the speed of the abrasive particles and to a narrowing of the diameter of the stream of abrasive particles.

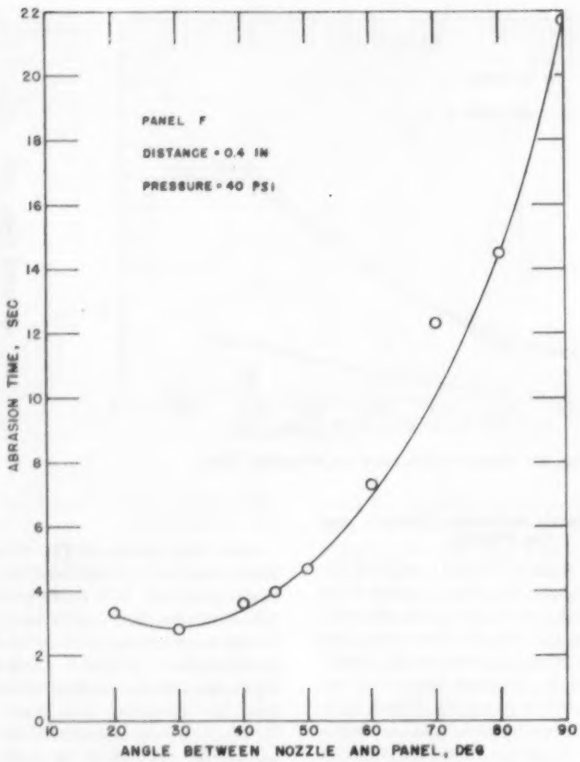

Fig. 5.—Effect of Abrading Angle on Abrasion Time.

Relation of Abrasion Time to Thickness

Expressing abrasion resistance in terms of a unit thickness assumes that the abrasion time varies linearly with thickness. Probably this assumption is true only to a first approximation; coating thickness, substrate thickness, substrate hardness or modulus, and even adhesion itself in the case of thin coatings, may affect the manner in which the impact energy of the abrasive particles is distributed and dissipated through the coating system, thereby superposing additional effects upon the intrinsic abrasion resistance of the coating material itself. The magnitude of these secondary effects is being studied in our continuing work with the Abrasive Jet Method. We hope, also, to evaluate the performance of other types of abrasive powders.

Statistical Analysis of Data

The variability of Abrasive Jet Method abrasion measurements may be seen from the data presented in Table VI. The coefficient of variation for Panel O was based upon three replicate values for each of sixteen different conditions of abrading distance and pressure and was calculated by the range method. The latter gives values of the standard deviation practically equivalent to that yielded by the standard formula provided the number of samples, as in this instance, is reasonably large. For all other panels in Table VI, the coefficient of variation was computed by the usual statistical formulas, as defined in the footnotes to the table.

From the data in Table VI, the average coefficient of variation for individual measurements by the Abrasive Jet Method is seen to be of the order of 5 per cent. The different test panels do not differ greatly from this average value of the variability, except for panels B and D. In these latter two cases, the higher variability results from inclusion of test results for various thicknesses of coatings arising from the thickness gradient in dip-coated panels. For the other panels, the effect of the thickness gradient was eliminated by making replicate measurements across

the panel rather than down the panel along the gradient. Although the technique of making replicate measurements along the thickness gradient increases the spread among replicate values, the average value is nonetheless accurate provided the test locations are chosen so as to balance out thickness effects. In fact, replicate measurements along the thickness gradient yield an average value that is typical of the panel as a whole, whereas replicates made across the panel yield a value that is applicable only across that strip of panel. The two techniques are comparable for a given material if, in each case, the abrasion time is expressed in terms of a unit average thickness.

Through the application of statistical methods[12] to the data that have been obtained, it can be shown that the coefficient of variation of 5 per cent, when applied to the technique of making five replicate measurements per panel, indicates an 80 per cent probability that a real quality difference of 10 per cent between panels will be detected; also it indicates that panels actually alike will be found so by the test method in 95 per cent of the cases. For detecting real differences of 20 per cent or greater, the statistical analysis indicates that the method will detect this difference in 95 per cent of the cases and will consider truly alike panels to be different in only 1 per cent of the cases; this can be done with only four replicates per test panel. For a 95 per cent probability of detecting a true 10 per cent difference between panels, eleven replicate measurements would be required. From a practical point of view, at least a 20-per cent difference between coating materials would be desirable before classifying one as being definitely superior to the other. On such a practical basis, the Abrasive Jet Method possesses a reproducibility entirely adequate to distinguish between different materials.

TABLE VI.—VARIABILITY[a] OF ABRASIVE JET METHOD MEASUREMENTS.

Panel	Abrading Angle, deg	Number of Replicates	Coefficient of Variation, per cent	Panel	Abrading Angle, deg	Number of Replicates	Coefficient of Variation per cent
O[b]	..	..	5.2	B[c]	90	6	7.0
					75	6	14.3
A	90	8	4.2		60	6	16.0
	45	8	11.6		45	6	13.6
X4-2	90	10	4.0		30	6	11.6
	45	10	4.1				
X4-7	90	6	5.0	C	90	3	1.0
	45	5	1.5		75	4	0.9
X4-8	90	5	4.0		60	4	3.0
	45	5	5.2		45	4	5.8
X5-1	90	5	5.0				
	45	5	5.1	D[c]	90	6	19.6
X5-2	90	3	1.6		75	6	18.8
	45	5	9.6		60	6	9.8
X6-1	90	5	5.6		45	6	21.0
	45	5	4.5		30	6	10.9

[a] Variability is expressed as the coefficient of variation and is equal to $100S/\bar{x}$, where $S^2 = \Sigma(x - \bar{x})^2/(N - 1)$; S = standard deviation; $\bar{x}$ = mean value; N = number of observations.

[b] For Panel O only, $S = \bar{R}/d_2$ (where $\bar{R}$ = average range and d_2 is obtained from tables of $\bar{R}/\sigma$ for n replicates per sample, where σ is the true standard deviation). The coefficient of variation for Panel O is based upon three replicates for each of 16 samples (48 values in all).

[c] The high coefficient of variation for Panels B and D is due to inclusion of the variability resulting from the thickness gradient down the dip-coated specimens.

Summary

A new rapid method for measuring the abrasion resistance of organic coatings on metals is described which utilizes a jet of fine abrasive particles under closely controlled conditions of pressure, distance, angle, and flow to abrade through the coating. The small scale of operation permits the economical use of a continuously fresh supply of abrasive material. Abrasion resistance is expressed in terms of the time required to abrade through a unit thickness of coating. Values are obtained with an average coefficient of variation of about 5 per cent.

The abrasion time depends strongly on the test conditions. It increases almost linearly with increasing nozzle-to-coating distance, decreases with increasing pressure, and decreases markedly with decreasing angle of abrasion from 90 down to about 30 deg; at lesser abrading angles, the abrasion time rises again.

It is possible that different abrading angles may give different correlations with actual service. It is postulated that a 90-deg test may simulate leading-edge erosion, while a 45-deg test may more nearly simulate the scuffing type of wear encountered during maintenance operations.

Acknowledgment:

This investigation was sponsored by the U. S. Department of the Navy, Bureau of Aeronautics. The helpful cooperation of A. M. Malloy of the Bureau of Aeronautics during the course of the work is gratefully acknowledged.

The authors express their appreciation to John Mandel of the National Bureau of Standards for his assistance in the statistical interpretation of the data obtained.

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Variability of Wool Content in Part Wool Blankets

By Emanuel Horowitz and William S. Connor

A variety of samples tested from two mills showed important sources of variation to be looms and batches.

A REVIEW of current specifications dealing with wool blankets indicates that ample consideration has not been given to the limitations inherent in the determination of the wool content and the difficulty in producing blankets with specified amounts of wool. In cooperation with Group 2, Subcommittee B-5, of ASTM Committee D-13 on Textile Materials, a project was undertaken to study several aspects of this problem.

In one experiment, the precision of the sulfuric acid and sodium hydroxide methods for wool analysis was determined by analyzing mixtures of wool, cotton, and viscose rayon fibers prepared to contain known amounts of wool (**1**).[1] In another investigation, samples from a single blanket were distributed to four laboratories in order to study the variability of the wool content in the blanket, the differences in precision among the laboratories, and the suitability of the acid and alkali methods of analysis.[2] The present work is concerned with the variability between blankets manufactured by two different mills to contain 10 per cent wool and the examination of some of the factors that contribute to their variability. The results are discussed on the basis of a statistical analysis of the experimental data.

Test Procedures

Sampling Plan

Each of the two mills provided 16 samples from its nominally 10 per cent napped wool blanket material. Eight samples were from green material and eight from yellow material. For each color the samples were selected in the following way: two looms were selected at random from the totality of looms that were weaving material from the same batch. After the material had been napped, two samples were taken from each loom. Each sample was 6 in. warpwise and 36 in. fillingwise.

For a different batch, these steps were repeated, care being taken to choose two new looms at random. Thus, for each combination of mill and color there were eight samples, representing two batches and four looms. Each sample was tagged with the name of the mill, the number of the batch, the number of the loom, the number of the sample, and the date the sample was taken.

Chemical Analysis

In the laboratory the 32 samples were arranged in random order, and a 2-g specimen was cut at a random location from each sample. The specimens were then analyzed by the sodium hydroxide method.[3]

The first step was to determine the oven-dried weights of the original specimens. Then the chloroform and water-soluble, nonfibrous materials were extracted, and the oven-dried weights of the extracted specimens were determined.

Each extracted specimen was placed in a boiling aqueous solution containing 5 per cent sodium hydroxide by weight to dissolve the wool. The weight of the cotton and viscose rayon residue was determined, corrected for the solubility effect (**2**), and the wool content calculated on the basis of the oven-dried weight of the original specimen. The values obtained were almost identical with those calculated on the basis of the oven-dried weights of the extracted specimens, since negligible amounts of chloroform and water-soluble matter were found to be present in the samples. The entire procedure was repeated at a different time, in order to obtain a duplicate analysis for each sample.

Results

The experimental results are presented in four sets: mill No. 1, green material in Table I; mill No. 1, yellow material in Table II; mill No. 2, green material in Table III; and mill No. 2, yellow material in Table IV. A summary of average percentages of wool for mills and colors is presented in Table V. Each of the five tables contains appropriate averages and analyses of variance.

Statistical Analysis

The analyses of variance assist in drawing conclusions from the data.[4] Of special interest are the variance ratios, since their magnitudes suggest conclusions about the relative importance of the several sources of variation.

The source of variation denoted as residual perhaps requires some explanation. It refers to the analytical error, that is, the error in duplicate determinations on specimens from the same sample under essentially homogeneous

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

[2] Unpublished report on the statistical analysis of wool blanket data.

[3] Federal Specification No. CCC-T-191b, Method 2101.1.

[4] Though the various averages as presented in the tables have been rounded to tenths, the analysis of variance computations are based on the averages before rounding.

TABLE I.—PER CENT WOOL IN GREEN MATERIAL FROM MILL NO. 1.

	Batch No. 1				Batch No. 2				Average
	Loom No. 1		Loom No. 2		Loom No. 3		Loom No. 4		
	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7	Sample No. 8	
Analysis No. 1	10.1	9.7	14.2	15.1	14.7	14.9	10.1	14.4	12.9
Analysis No. 2	9.6	8.6	14.1	14.5	14.5	13.8	9.7	14.5	12.4
Average:									
Sample	9.8	9.2	14.2	14.8	14.6	14.4	9.9	14.4	
Loom	9.5		14.5		14.5		12.2		
Batch	12.0				13.4				

ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	Estimated Contribution to Total Variability, per cent
Batches[a]	1	7.16	(A) 7.16	(A/B) 0.2[e]	0
Looms[b]	2	60.08	(B) 30.04	(B/C) 5.5[e]	68
Samples[c]	4	21.68	(C) 5.42	(C/E) 54.2[f]	30
Runs[d]	1	0.95	(D) 0.95	(D/E) 9.5[g]	1
Residual	7	0.67	(E) 0.10		1

[a] Of the same color and from the same mill.
[b] From the same batch.
[c] From the same loom.
[d] Specimens from the same sample, analyzed at different times.
[e] Not significant—the ratio does not exceed the 5 per cent critical value.
[f] Significant at the 0.01 level of significance.
[g] Significant at the 0.05 level of significance.

TABLE II.—PER CENT WOOL IN YELLOW MATERIAL FROM MILL NO. 1.

	Batch No. 3				Batch No. 4				Average
	Loom No. 5		Loom No. 6		Loom No. 7		Loom No. 8		
	Sample No. 9	Sample No. 10	Sample No. 11	Sample No. 12	Sample No. 13	Sample No. 14	Sample No. 15	Sample No. 16	
Analysis No. 1	10.6	10.3	12.5	12.4	10.3	12.8	12.8	12.4	11.8
Analysis No. 2	9.5	11.0	12.1	11.3	10.1	12.2	11.9	11.4	11.2
Average:									
Sample	10.0	10.6	12.3	11.8	10.2	12.5	12.4	11.9	
Loom	10.3		12.0		11.4		12.2		
Batch	11.2				11.8				

ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	Estimated Contribution to Total Variability, per cent
Batches[a]	1	1.10	(A) 1.10	(A/B) 0.3[e]	0
Looms[b]	2	7.15	(B) 3.58	(B/C) 2.4[e]	34
Samples[c]	4	6.06	(C) 1.51	(C/E) 8.0[f]	44
Runs[d]	1	1.32	(D) 1.32	(D/E) 7.0[g]	9
Residual	7	1.32	(E) 0.19		13

[a] Of the same color and from the same mill.
[b] From the same batch.
[c] From the same loom.
[d] Specimens from the same sample, analyzed at different times.
[e] Not significant—the ratio does not exceed the 5 per cent critical value.
[f] Significant at the 0.01 level of significance.
[g] Significant at the 0.05 level of significance.

experimental conditions. The analytical error is estimated by extracting the square root of the residual mean square.

Each variance ratio listed in the tables is the ratio of two of the mean squares. For example, the variation among batches is compared with the variation among looms from the same batch. This is a reasonable comparison because samples from different batches are subject to the same loom-to-loom variation as samples from the same batch, and they are, in addition, subject to batch-to-batch variation (unless there are no differences among batches).

In each instance, it is expected that the variance ratio will be unity or greater. Owing to the small number of samples, there are cases in which the ratio is less than unity; no significance is attached to such cases.

The values of the variance ratio are judged by comparison with accepted critical values. Some ratios exceed the 5 per cent critical value and others exceed the 1 per cent critical value.[5] The last column under Analysis of Variance in Tables I to IV lists estimates of the per cent contribution of each source of variation to the total variability and was calculated by the method of components of variance (**4**).

Discussion of Results

For the four sets of determinations, the estimated standard deviations are 0.31, 0.43, 0.33, and 0.44 per cent.

[5] To return to the example above, suppose that many experiments like the present one were conducted, and for each experiment the variation among batches was tested against the variation among looms from the same batch. Suppose further that *there were no differences among batches*. Then the 5 per cent critical value of the variance ratio is that value which would be exceeded in 5 per cent of the experiments. The 1 per cent value is that value which would be exceeded in 1 per cent of the experiments. Exceeding the 1 per cent critical value constitutes more conclusive evidence for variability than does exceeding the 5 per cent critical value. For the critical values see Table F in reference (**3**).

TABLE III.—PER CENT WOOL IN GREEN MATERIAL FROM MILL NO. 2.

	Batch No. 5				Batch No. 6				Average
	Loom No. 9		Loom No. 20		Loom No. 11		Loom No. 12		
	Sample No. 17	Sample No. 18	Sample No. 19	Sample No. 29	Sample No. 21	Sample No. 22	Sample No. 23	Sample No. 24	
Analysis No. 1	11.3	12.3	12.3	12.2	15.1	13.7	14.2	13.5	13.1
Analysis No. 2	11.2	11.7	11.9	11.6	13.7	12.6	12.9	13.1	12.3
Average:									
Sample	11.2	12.0	12.1	11.9	14.4	13.2	13.6	13.3	
Loom	11.6		12.0		13.8		13.5		
Batch	11.8				13.6				

ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	Estimated Contribution to Total Variability, per cent
Batches[a]	1	12.78	(A) 12.78	(A/B) 49.2[e]	72
Looms[b]	2	0.53	(B) 0.26	(B/C) 0.5[f]	0
Samples[c]	4	2.23	(C) 0.56	(C/E) 5.0[e]	11
Runs[d]	1	2.18	(D) 2.18	(D/E) 19.8[g]	12
Residual	7	0.78	(E) 0.11		5

[a] Of the same color and from the same mill.
[b] From the same batch.
[c] From the same loom.
[d] Specimens from the same sample, analyzed at different times.
[e] Significant at the 0.05 level of significance.
[f] Not significant—the ratio does not exceed the 5 per cent critical value.
[g] Significant at the 0.01 level of significance.

TABLE IV.—PER CENT WOOL IN YELLOW MATERIAL FROM MILL NO. 2.

	Batch No. 7				Batch No. 8				Average
	Loom No. 13		Loom No. 14		Loom No. 15		Loom No. 16		
	Sample No. 25	Sample No. 26	Sample No. 27	Sample No. 28	Sample No. 29	Sample No. 30	Sample No. 31	Sample No. 32	
Analysis No. 1	11.8	11.0	11.1	11.5	12.9	11.3	12.7	11.5	11.7
Analysis No. 2	11.4	11.4	10.9	12.4	12.1	10.6	12.6	12.1	11.7
Average:									
Sample	11.6	11.2	11.0	12.0	12.5	11.0	12.6	11.8	
Loom	11.4		11.5		11.8		12.2		
Batch	11.4				12.0				

ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	Estimated Contribution to Total Variability, per cent
Batches[a]	1	1.16	(A) 1.16	(A/B) 4.5[e]	15
Looms[b]	2	0.51	(B) 0.26	(B/C) 0.2[e]	0
Samples[c]	4	4.19	(C) 1.05	(C/E) 5.5[f]	59
Runs[d]	1	0.01	(D) 0.01	(D/E) 0.1[e]	0
Residual	7	1.33	(E) 0.19		26

[a] Of the same color and from the same mill.
[b] From the same batch.
[c] From the same loom.
[d] Specimens from the same sample, analyzed at different times.
[e] Not significant—the ratio does not exceed the 5 per cent critical value.
[f] Significant at the 0.05 level of significance.

Since these estimates are of about the same magnitude and there is no *a priori* reason to expect the analytical error to depend on the particular combination of mill and color under investigation, these estimates may be averaged to give 0.38 per cent analytical error. This result is in excellent agreement with the 0.37 per cent found from 32 determinations in a previous study (1).

Study of the averages reveals that the second analysis generally gave lower results than the first analysis. This downward shift is indicated for each set of determinations, though not markedly for the yellow material of mill No. 2. Averaged over the four sets, the difference was 0.46 per cent. Such variations in results, due to conducting analyses at different times, are encountered in many laboratory procedures and deserve consideration in studies of precision.

From Table V it is evident that the mills agree remarkably well in average per cent wool, but there is some indication that the per cent wool is higher for green material than it is for yellow. This difference between colors is about the same for the two mills.

Of considerable interest is the observed grand average for the two mills, 12.2, which is higher than the nominal 10 per cent. The difference between 12.2 and 10 is statistically significant at the 1 per cent level of significance. This additional 2.2 per cent wool may represent the margin of safety being used to assure compliance with specification requirements. With regard to variability between looms of the same batch or between batches from the same mill, notable differences in uniformity of the material appear to exist between the two mills. In mill No. 1, no variability between batches could be detected, although looms from the same batch varied considerably. In mill No. 2, the looms from any given batch were quite uniform, but batches differed from each other. For both mills and both colors, samples from the same loom showed considerable variability.

The original experimental design

called for the participation of four mills, but unfortunately only two mills were able to cooperate in this study. The larger number of measurements incorporated into the original design was intended to increase the sensitivity of the variance ratio term in order better to characterize the factors under investigation. In view of the reduced number of measurements, the variance ratio term suffered somewhat from a decrease in sensitivity. Nevertheless the conclusions, based on the statistical analysis of the data, seem to be justified.

Investigations of the sort described in this paper would furnish the data that are needed to formulate an adequate sampling plan for part wool blankets and provide realistic specification requirements for wool content.

TABLE V.—SUMMARY OF DATA FOR MILLS AND COLORS.

Mill	Batch	Per Cent Wool		
		Green	Yellow	Mill Average
No. 1	No. 1	12.0	11.2	
	No. 2	13.4	11.8	
	Average	12.7	11.5	12.1
No. 2	No. 1	11.8	11.4	
	No. 2	13.6	12.0	
	Average	12.7	11.7	12.2
Grand average		12.7	11.6	12.2

ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio
Mills[a]	1	0.32	(A) 0.32	(A/D) 0.1[d]
Colors[b]	1	19.03	(B) 19.03	(B/D) 3.4[d]
Mills and colors[c]	1	0.13	(C) 0.13	(C/D) 0.0[d]
Residual	4	22.19	(D) 5.55	

[a] Effect of mill, pooling the results for both colors.
[b] Effect of color, pooling the results for both mills.
[c] Variation in color effect from mill to mill.
[d] Not significant—the ratio does not exceed the 5 per cent critical value.

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Preparation of Controlled Odorous Atmospheres for Olfactory Research

By Ashley D. Nevers

Considerations involved in presenting a controlled odor stimulus to an observer, and an improved apparatus for accomplishing it.

IN RESEARCH on odor phenomena, the need for a closely controlled stimulus and means of presentation is widely recognized (**2,4,6,8,9,10**).[1] A large number of devices have been developed and used for this purpose: Wenzel (**10**) has published a critical review of such devices and has described an improved olfactometer intended to eliminate deficiencies of previous designs. Wenzel's apparatus depends on vapor-liquid equilibrium for attaining a known concentration of odorant. Its utility is therefore confined to pure compounds so that composition will not change as evaporation proceeds. This difficulty is eliminated in the instrument to be described here.

Some investigators have used odor test rooms for maintaining a definite concentration of material in the vapor phase. Turk (**7**) has described a means for control of vapor concentration in enclosed spaces which depends essentially on gaseous diffusion; hence it is not suitable for mixtures because the constituents would be partially separated during the diffusion process. Foster (**4**) refers to an olfactorium, but details are not described. McKinley and Larratt (**6**) and Deininger and McKinley (**2**) have described the development and construction of a test room with surfaces that are practically odorless; they achieve a known odorant concentration by a "one-shot" addition from a microburet, followed by efficient air circulation, prior to entering the chamber for observations.

All these room test procedures have certain disadvantages, among which are high first cost, time lost for purging between tests, and lack of portability. In addition, as Turk has pointed out, a "one-shot" addition, particularly when dealing with very low concentrations, leads to progressive reduction in vapor concentration as the odorous material becomes adsorbed on the room surfaces.

Olfactometers and osmoscopes (including test rooms) may be broadly classified by function into two main groups:

I. Instruments intended for controlled presentation of a pre-existing odorous atmosphere to an observer. An apparatus for evaluating odor in air pollution studies would fall into this category.

II. Instruments by which the odorous atmosphere may be prepared and presented to an observer. The odorant

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

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concentration is quantitatively known in some instruments of this type, but in others it is not.

For group No. II instruments, procedures for preparing an odorous atmosphere fall into three categories: (1) saturation of the carrier gas by contacting with liquid odorant, that is, attainment of vapor-liquid equilibrium; (2) contacting the carrier gas with liquid with no attempt to attain equilibrium; and (3) total vaporization. Of these, procedure No. 3 is clearly preferable when the characteristics of the odorant permit, because (a) it permits calculation of the concentration in the absence of vapor-pressure data, and (b) it can be used equally well with mixtures and pure compounds. Procedure No. 1 also allows a quantitative knowledge of odorant concentration, either by direct measurement or by calculation based on vapor pressure, but it cannot be used for odorant mixtures because of the change in composition which occurs as the liquid evaporates.

So far as is known to the author, no apparatus of group No. II type has been developed which relies on continuous total vaporization. Such an instrument is the subject of this paper. The device may also be used for evaluating an existing atmosphere (group No. I operation) if the injection feature is not used and a suitable means is provided for driving the atmosphere sample through the apparatus.

The apparatus was developed specifically for use in evaluating gas odorants, sometimes designated as warning agents. Because these odorants, which consist mainly of mercaptan or sulfide mixtures, are so highly potent, the preparation of a suitably dilute mixture for testing on a laboratory scale posed a special problem. Practical use concentrations of commercial gas odorants are of the order of 1 lb of odorant per million cubic feet of gas. To obtain this concentration on a laboratory scale, it was necessary to inject continuously a dilute solution (2.64×10^{-3} g per ml) of odorant in absolute alcohol at the rate of 0.0055 ml per min into a methane stream at a rate of 0.9 liter per min. In the original model of the apparatus, this injection rate was achieved by a slow-speed screw device driving the plunger of a hypodermic syringe; in the present model the screw has been replaced by a cam driven by a synchronous motor.

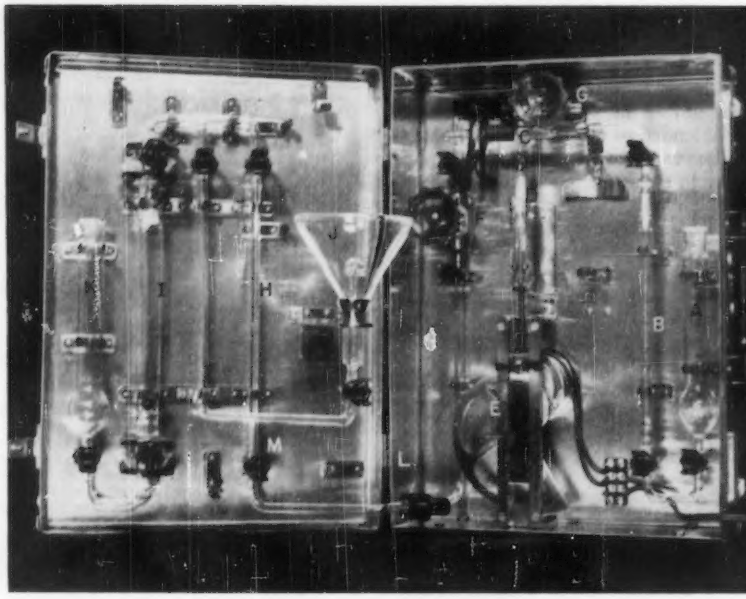

Fig. 1.—Apparatus for Odorant Evaluation.

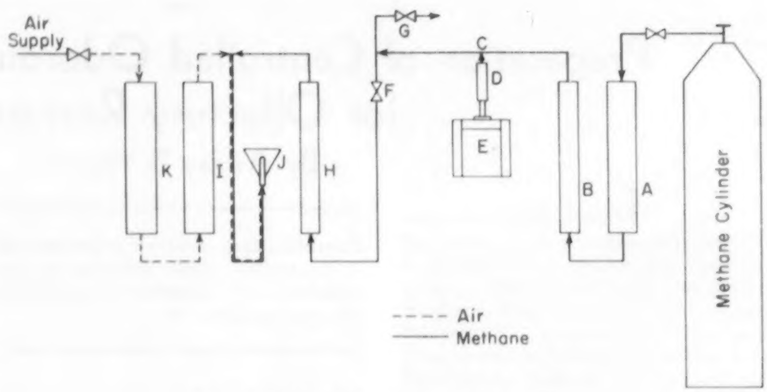

Fig. 2.—Diagram Showing Flow Arrangement.

A—scrubber
B—rotameter
C—injection point of odorant solution
D—1-ml hypodermic syringe
E—cam
F, *G*—stainless steel needle valves
H, *I*—rotameters
J—sniffing funnel
K—scrubber
L, *M*—ball-and-socket connections

In addition to the mechanical requirements dictated by the very low odorant concentration desired, an effort was made in the design of the apparatus to satisfy the following desirable objectives:

- There should be flexibility, permitting use as either a group No. I or a group No. II type instrument. For group No. II instruments, any of the above-listed odorizing procedures might be used but total vaporization, when feasible, would be preferred. If desired, operation as a group No. I apparatus could be carried out using the modifications indicated above.
- A continuous flow system is preferable to intermittent release of odorous mixture into a static enclosure (as in room tests). There are two main reasons for this: (a) the odorant concentration is known with more certainty and is constant with time, and (b) changes in odorant concentration and replacement of one odorant by another may be made more rapidly. The time required for purging the apparatus between changes is greatly reduced.
- The apparatus should be compact, portable, and readily dismantled for cleaning.
- Provision should be made for rapid and convenient changes either in concentration or identity of odorant.
- At the point of presentation to the observer, stream velocity should be low enough so that no pressure or velocity effect, which might otherwise confuse the smell impression, is noted. On the other hand, the stream should issue from the device fast enough so that no random dilution by the outside air is experienced. In other words, the size of the opening for sniffing should be in accord with the range of flow rates to be encountered.
- The materials contacting the odorous

atmosphere should not adsorb the odorant to any significant extent.

An apparatus combining these features has been in use at the Pennsylvania Salt Manufacturing Co. laboratory for some months. Originally developed expressly to compare intensities of experimental odorants for natural gas, it appears to be applicable to a wider scope of studies on odor phenomena in general.

The instrument is shown in Fig. 1. A flow diagram is presented in Fig. 2. The apparatus functions by the familiar stream-flow and dilution principle with the important refinement that a means is provided for continuous injection of odorant or odorant solution into a flowing carrier gas, the odorant or solution being completely vaporized at the zone of injection.

The carrier gas is dried and deodorized in passing through scrubber *A* (Fig. 1) which, in use, is packed with silica gel and activated carbon. The gas is then metered through rotameter *B*. Odorant solution is injected at point *C* from a 1-ml hypodermic syringe *D* using a 25-gage hypodermic needle. The syringe is driven at a constant rate by cam mechanism *E*, powered by a synchronous motor. The odorized gas is then split into two streams, in any desired ratio, by adjustment of stainless steel needle valves *F* and *G*. One stream is vented to a laboratory hood or a point distant from the apparatus; the other stream is metered through rotameter *H* into a stream of air which has been deodorized by passage through scrubber *K* similar to scrubber *A*.

In gas odorant work, cylinder methane is conveniently used for the carrier gas, and dilution air is supplied by an air compressor.

The air rate is measured by rotameter *I*. Observers sniff the mixture at sniffing funnel *J*, which is fitted internally with symmetrically arranged orifices to direct the flow radially against the sides of the funnel.

The various glass elements are connected by ball-and-socket joints. Surfaces contacting the odorous mixture are mainly glass. There is slight contact with stainless steel (at the valves) and with an insignificant amount of rubber at the point of liquid injection.

By taking apart ball-and-socket connections at points *L* and *M* and relocating the funnel and support, the case may be closed and carried about.

From the known flow rates, liquid injection rate, and solution concentration, the odorant concentration in the gas is readily calculated. The odorized gas thus prepared is suitably diluted with air for the test. The degree of dilution may be changed instantly by adjustment of one valve.

At the injection point the hypodermic needle enters the line for the carrier gas through a gum rubber sleeve and a small hole in the wall of the glass tubing. In Fig. 1 the sleeve has been slipped aside to show the internal arrangement. This is the only point at which the test gas contacts rubber. The needle is surrounded by a patch of wicking material, and a small nozzle is incorporated so that the gas will impinge directly on the tip of the needle with a sufficiently high velocity to vaporize the odorant mixture as fast as it issues from the needle.

Relatively little work has been reported on the sorptive properties of various surfaces for odorous materials, but glass is probably the most desirable construction material from the standpoint of minimum odor adsorption. Zwaardemaker's data (**11**) show that glass is generally superior to such other materials as copper, aluminum, steel, nickel, and porcelain, although with a few odorants it may be inferior in specific instances. Deininger and Sullivan (**3**) apparently considered glass to be nonsorptive enough to justify using glass containers in studying the sorptive properties of other surfaces.

The vapor pressure of the material to be injected determines the minimum gas flow necessary for a given liquid feed rate. In practice the liquid feed rate is fixed at 0.0067 ml per min; it has been found by experience that the following flow rates of the carrier gas are adequate to vaporize materials with boiling points as indicated or lower:

170 C (butylcellosolve) . . >6 liters per min
146 C (methylamylacetate)
. . . . 6 liters per min
125 C (*n*-butylalcohol) . . . . 1 liter per min

Materials of lower vapor pressure may be vaporized continuously if diluted with a low-boiling, noninterfering solvent. If a suitable solvent is not available, or if very nonvolatile materials are involved, a wick soaked with the material in question may be inserted into the gas stream. The odorant concentration in the gas may be calculated, provided the odorant is a pure compound and vapor pressure data are available.

Finally, for techniques intended to simulate practical conditions wherein the odorant is often a complex liquid or solid mixture, the carrier gas may be led through a vessel suitably packed with the material under examination. This latter technique has been employed by Barail (**1**), Jackson, *et al.* (**5**), and doubtless many others. In this latter type of work, cognizance should be taken of the change in composition of the mixture as evaporation proceeds. The odorant charge should be large to minimize this effect.

The described apparatus serves primarily as a convenient tool by which a variety of materials, including mixtures, may be diluted to known concentrations in a stream of carrier gas and by which the dilutions may be varied over a wide range. The most valid mode of presentation of the odorous mixture to a subject is not clear, and discussion of this problem is beyond the scope of this paper. In use, the pragmatic approach has been chosen, and observers have used the natural sniff for threshold determinations.

Acknowledgment:

The detailed design and assembly of the portable apparatus was carried out by Fischer & Porter Co., Hatboro, Pa. Steps are being taken to have it patented.

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Effect of Streamlining on Stresses in the Perkins Tensile Strength Briquet for Refined Paraffin Waxes*

By W. P. Ridenour[1] and John R. Bowman[1]

EDITOR'S NOTE.—This paper which appeared in the July issue of the BULLETIN is reprinted this month showing the correct Fig. 1, which was omitted from the July issue.

A review of events leading to adoption of the Mellon modified Perkins mold for the proposed method of test for the tensile strength of paraffin wax.

AT THE February, 1954, meeting of Section I on Strength Tests of the TAPPI-ASTM Technical Committee on Petroleum Wax, it was voted to recommend publication of a revised tensile strength method,[2,3,4] embodying a streamlined modification of the Perkins mold,[5] as tentative ASTM and TAPPI methods. In view of this action, it was thought that a short note on the studies made at Mellon Institute some years ago[6] on the effects of streamlining on the stresses in a wax briquet while under tension would be of interest and should be in the record.

The old Perkins paraffin wax briquet is noted for the irregular way in which it breaks under tension. Even with very careful handling, breaks often occur outside of the shank. This, of course, contributes to poor reproducibility and means the loss of a high percentage of briquets out of a given number of measurements. In an effort to overcome these difficulties, the Wax Section of the Gulf Fellowship at Mellon Institute in 1938 undertook a short study of the stresses that occur in the Perkins briquet under tension.[6] It was found, as might be expected, that the square shape of the old Perkins briquet when under tension contains a complex pattern of highly irregular stresses, explaining its erratic behavior on rupture. It was further shown that streamlining smoothed out the stresses and improved reproducibility substantially, and that the breaks could be made to occur at the middle of the shank over a nearly constant cross-sectional area.

The first streamlined mold used by the Mellon Institute Laboratory for routine testing had a narrower and thicker shank than the old Perkins mold, but the same cross-sectional area at the mid-point of the shank. Experience with this mold was very good, and for several years it was used exclusively in the work of the Gulf Fellowship on paraffin wax. Later on, the old Perkins molds were streamlined, as shown in Fig. 1. Both the streamlined Perkins mold and the Mellon Institute streamlined mold were used in the second round-robin test in 1951–1952 for tensile strength as conducted by Section I of the TAPPI-ASTM Technical Committee on Petroleum Wax. This work showed that the agreement between the two was very good and that both streamlined molds were much superior to the old Perkins mold with respect to the type and position of the fracture obtained and reproducibility of results.

Stress Analysis

Transparent bakelite models were used to determine the stress distribution developed in briquets of the Perkins and the Mellon designs. The forms were rough cut from a sheet of $\frac{1}{4}$-in. bakelite

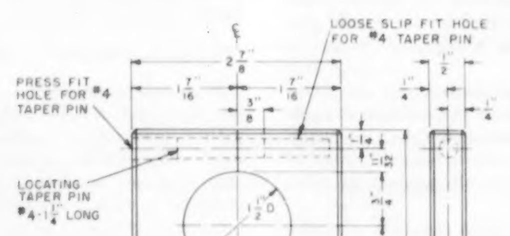

Fig. 1.—Perkins Two-Piece Wax Mold Mellon Modification, for Determination of Tensile Strength.

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* Published under the jurisdiction of Section I on Strength Tests of the TAPPI-ASTM Technical Committee M on Petroleum Wax of ASTM Committee D-2 on Petroleum Products and Lubricants.

[1] Multiple Fellowship of Gulf Research and Development Co., Mellon Institute, Pittsburgh, Pa.

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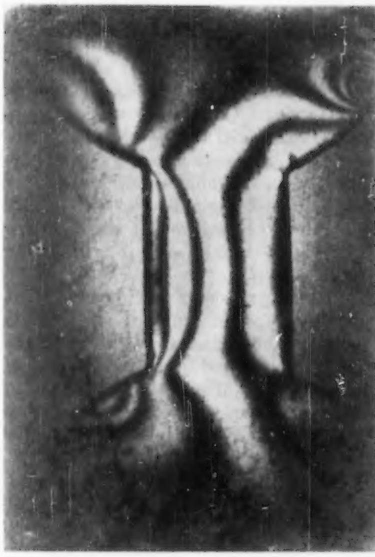

Fig. 2.—Perkins Design Showing Concentration of Stresses at Corners and Throughout Shank Area

Fig. 3.—Mellon Design Entirely Free of Stress Irregularities in the Shank Section.

and filed to fit the molds. A buffing wheel was used to give a smooth finish, and the internal stresses were relieved in an annealing oven. The annealed models were then placed under tension in a polarized-light machine and photographed.

The Perkins design (Fig. 2) shows a concentration of stresses at the sharp corners and throughout the shank area. It is believed that this condition is responsible for the erratic break pattern commonly associated with this design. The Mellon design (Fig. 3) is entirely free of stress irregularities in the shank section and, as expected, the breaks occur uniformly at the minimum cross-section.

On the basis of these results, the modified design was adopted by the Gulf Fellowship Laboratory for all tensile strength testing of refined wax. Tensile strength test data indicate that the elimination of sharp corners reduces the number of irregular breaks and breaks outside of the shank, and improves the precision of the test.

Microscopic Examination of Glass Fiber Reinforced Plastics

By M. K. Weber

Taking a leaf from the metallurgist's notebook, there is suggested a technique similar to his for examining specimens of reinforced plastics and revealing features of fine structure and defects not readily apparent from ordinary examination.

Much useful information can be obtained from microscopic examination of plastic materials reinforced with glass fibers. A technique for preparing samples of such materials for microscopic examination is described in this paper.

Microscopic examination can be used to obtain information on the distribution of resin and glass fibers, presence of flaws, and product uniformity. These characteristics are important in product quality control in manufacture and are also important in development of new products and in improving manufacturing methods.

Although reinforced plastics have high mechanical strength, they may suffer damage in use at stress levels below their ultimate strength with no visible signs of the damage. This permanent injury usually takes the form of internal cracks or fissures which can be observed readily under the microscope. The degree of damage can be assessed from a study of their location, frequency, and size. Such examinations are useful in connection with both laboratory and service tests.

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Type of Reinforced Plastics Examined

Primary interest was focused on tubular goods. Some samples were from commercial production and others from a new product development program. They were made with either chopped fibers, roving, or yarn, and either polyester or epoxy resins. Flat laminates made from glass cloth and the same resins were examined as part of the development program.

Although the polishing and examination methods used were developed for these materials, it seems likely that the methods would be useful for the examination of other types of reinforced plastics.

Procedure

The methods of sample preparation and examination were adapted from standard metallographic techniques.

M. K. WEBER, Chemist, Materials Engineering and Corrosion Department, Shell Development Co., has been in the field of nonmetallic materials of construction for oil field and chemical process equipment since 1945 with emphasis during the last five years on evaluation of glass-fiber-reinforced plastic tubular goods.

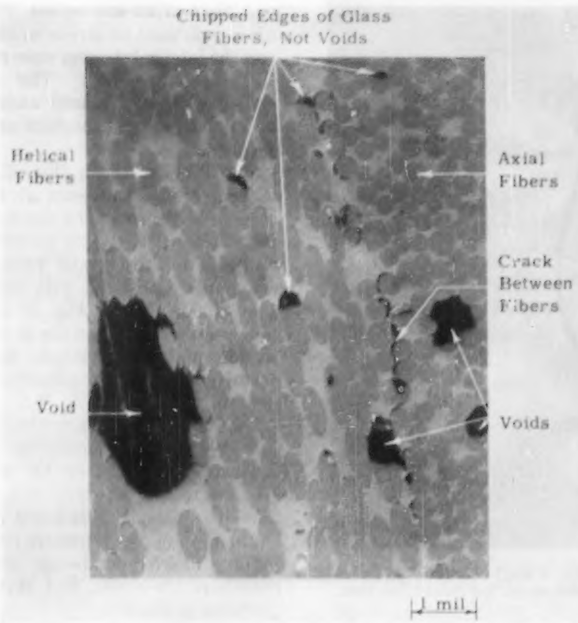

Fig. 1.—Cross-Section of Glass Fiber Plastic Tubing Containing Helical and Axial Plies. Vertical bright field illumination.

Voids in both types of plies and crack between plies.

Specimens of suitable size were cut, ground smooth on power-driven wet abrasive belts, and then given a very high polish on two wet cloth-covered laps using successively finer abrasive powders. The polishing was continued until there were few if any fibers with chipped edges; this was necessary to show clearly structural details or defects. The time required for preparation ran from 1 to 3 hr per sample. The specimens were then ready for examination without use of stains or etchants. Low-power examinations were made with a wide field binocular microscope. Photomicrographs were made at magnifications up to 1000 diameters with a Bausch & Lomb Research Metallograph.

Preparation of Samples for Polishing

Tubing samples up to 4 in. in diameter were prepared as full ring sections ½ to 1 in. long. They were cut square with the axis using either hand- or power-operated hacksaws. The saws were sharp, and excessive force on the blade was avoided to minimize tearing and delamination of the edges. The full ring sections provided a large area to determine uniformity of product and the extent of circumferential cracking. It was difficult to obtain a perfect polish over the entire surface of the full ring section, but perfection in polishing was found not to be essential; most of the principal features could be observed with a reasonably good polish.

Special sections were taken for supplementary information. In one the tube was cut across a diameter and parallel to the axis to permit examination of fiber ends which had been wrapped at an angle nearly 90 deg to the axis. Another useful section was prepared by grinding a flat on the outer wall at a small acute angle to the axis. This permitted observation of the direction and size of voids in several layers of the laminate.

Relatively small sections of flat laminates (about 1 in. long) were bolted together into bundles about 0.5 to 0.8 in. thick. It had been found that thin samples were difficult to hold vertical in edge polishing, with undesirable rounding of edges resulting. The greater stability of the bundles produced flat surfaces with excellent edges. Because different resins wear and polish at different rates, epoxy and polyester resin laminates were polished in separate bundles.

Polishing

The steps used in polishing are:

1. Grind the surface flat with a wet belt grinder using either 80- or 120-grit abrasive. Grind away sufficient material to ensure removal of any damage caused by sawing.
2. Grind on a 600-grit wet belt until all scratches from the first abrasive have been removed.
3. Polish on a wet lap using levigated

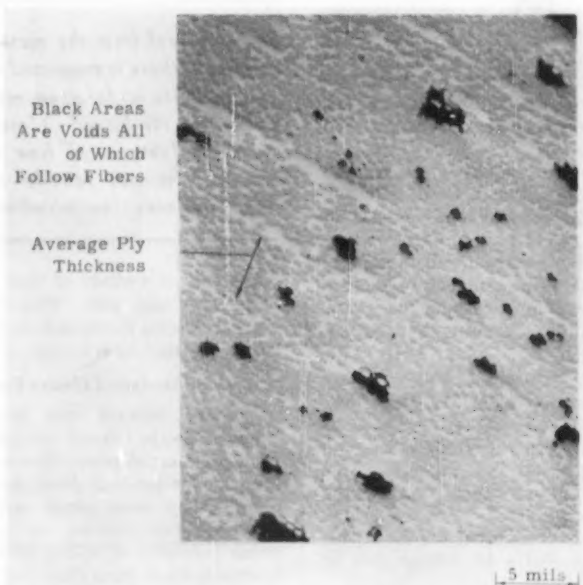

Fig. 2.—Cross-Section of Glass Fiber Plastic Tubing Containing Only Helical Plies. Vertical bright field illumination.

Voids small but frequency high.

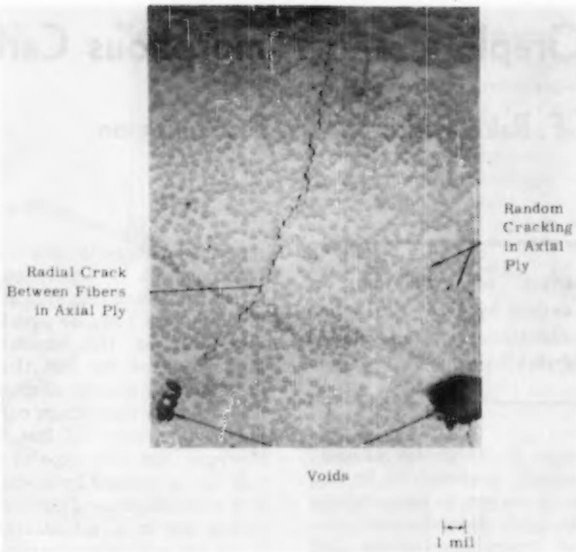

Fig. 3.—Cross-Section of Glass Fiber Plastic Tubing Containing Helical and Axial Plies. Vertical bright field illumination.

Large radial and random cracking in axial ply.

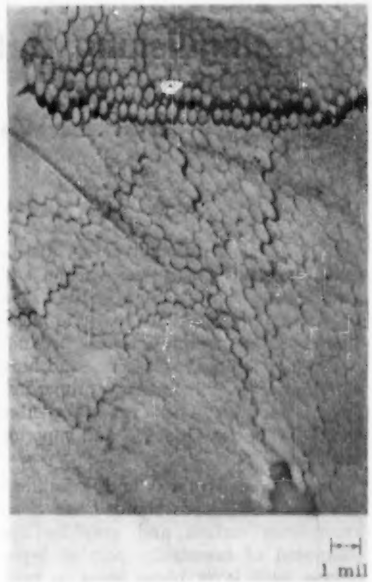

Fig. 4.—Cross-Section of Glass Fiber Plastic Tubing Containing Woven Glass Fiber Tape. Vertical bright field illumination.

Extensive random cracking.

alumina until all scratches from the 600-grit belt have been removed.

4. Polish finally on a wet lap using an extremely fine alumina powder.

Thorough washing with water between steps is important to avoid carry-over of coarse abrasive. The first two steps are fast; the last two become progressively slower.

Fast mechanical dry grinding was avoided to prevent overheating of the resin and possible damage to the surface. These steps may be accomplished more slowly by wet or dry hand grinding on metallographic emery papers on a flat surface. Although the surface obtained from a well-worn 600-grit wet belt is preferred, a final metallographic paper of grit No. 0000 is adequate.

The first polishing is done with levigated alumina suspended in water containing small amounts of glycerine and soap on billiard cloth. Cleanliness of the laps is important. Polishing powder should be scrubbed off at the end of the day, and scrubbing periodically during the day is beneficial.

The final polish is produced on a wet lap covered with a high-quality cloth used for the finest metallographic finishes. A gamma alumina powder of less than 0.1 μ size made by direct calcination proved to be most successful. Particle size was uniform and cutting action fast.

Staining and Etching

Staining of the resin was found to be unnecessary. The use of ink for location of some cracks and crevices was sometimes helpful, especially if applied while observing the specimen under the binocular microscope at low magnifications (about 30 ×).

Some experiments were made with hydrofluoric acid as an etchant for glass, but these were not successful. Although light or heavy attack on the glass, with or without subsequent polishing, did improve contrast between the resin and glass fiber ends under normal vertical illumination in the Metallograph, all details of cracks and fissures were either lost or badly confused. The cracks could be located under polarized light but could be detected as well with this light when unetched.

Microscopic Examinations

Microscopic examinations were made at low power, 30 ×, with a wide field binocular instrument. It was used to count plies, voids, cracks, and other defects, and for rapid general examination. A graduated scale in one eyepiece permitted measurements.

Detailed examinations at high magnifications were made with a Bausch & Lomb Research Metallograph. Photomicrographs up to 1000 × have been made with this equipment. Most examinations were made with vertical bright field illumination under which cracks and voids were most readily defined. It was essential for best definition that the light source be thrown off center to give relief to the surface, to cast shadows into voids, and to increase the contrast between glass and resin. Observations under this type of illumination were supplemented with vertical, polarized light which was useful to substantiate conclusions. Dark field illumination and transmitted light from an outside source can be useful at times.

Figure 1 shows the cross-section of a tube made of crossed helical plies with additional fiber reinforcement parallel to the axis (axial plies). The relatively tight packing of the fibers is shown as are the shape and size of voids. There is a crack between helical and axial plies. Differentiation between chipped edges of glass fibers and voids are noted.

Figure 2 shows the cross-section of a tube made of crossed helical plies wound on a mandrel. The relatively tight packing of the fibers, thickness of plies, and size, shape, and location of voids are readily observed. Since the fibers are about 0.0004 in. in diameter, it can be seen that these voids are quite small.

Large and small cracks are shown in Figs. 3 and 4. The large ones are readily visible under the wide field binocular microscope at 30 ×. However, the metallographic microscope is necessary to find and trace the small cracks or crevices.

Distinguishing Between Graphitic and Amorphous Carbon

By P. L. Walker, Jr., J. F. Rakszawski, and A. F. Armington

A comparison of estimations of graphitic carbon by X-ray diffraction and a recently suggested ASTM "float and sink" test.

THE ability to distinguish between amorphous carbon and graphitic carbon (pure graphite) is a practical necessity. For many applications, graphite is the premium product because of its higher electrical and heat conductivity, lubricating properties, lower reactivity to gases, greater thermal-shock resistance, and superior machinability.

Biscoe and Warren[1] and Franklin,[2] among others, have shown that both amorphous carbon and graphite are composed of essentially parallel layer planes, each layer plane being in turn composed of a number of condensed benzene rings. However, in amorphous carbons the stacked layer planes are found to be randomly oriented, whereas in graphite the layer planes have a fixed "three dimensional" order. The order affects the spacing between layer planes, which in turn is thought to account for the majority of the differences in properties between these two forms of carbon.

Amorphous carbon varieties are numerous and include all coals, cokes, pitches, and carbon blacks. Graphitic carbon is less plentiful and, at the moment, is taken as the carbon that has the smallest spacing between layer planes.[2] Ceylon natural graphite is an example. Carbons are also found that run the gamut between completely amorphous and completely graphitic material. These intermediate carbons show a degree of "three dimensional" ordering, usually produced by heating an amorphous carbon to temperatures above 2000 C.[3,4] A mechanical mixture of an amorphous carbon and Ceylon natural graphite can also be considered an intermediate carbon insofar as its over-all properties and X-ray analysis are concerned.

Classically, the method used for the distinction between amorphous and graphitic carbon is based on the fact that graphite can be converted to graphitic acid by strong oxidizing agents whereas amorphous carbon is unaffected.[5] However, this technique has been found by numerous workers,[5] including the present authors, to be a time-consuming, tedious, and sometimes dangerous procedure, which is not practical as a routine test.

Recently ASTM Committee D-2 on Petroleum Products and Lubricants published a suggested procedure for the determination of amorphous carbon.[6] It is a "float and sink type of test that" uses ethylene bromide (specific gravity 2.18–2.19) as the separating fluid. It is based on the fact that graphite has a specific gravity of approximately 2.26, whereas amorphous carbons have a specific gravity of less than 2.18. However, the only type of separation that can be realized by this technique is that where the amorphous and graphitic carbon are in a mechanical mixture. If the amorphous and graphitic carbon are integrally mixed within the same crystallite (and, hence, particle), as is the case[2] for heat-treated carbons, these two types of carbon will not be separated by the above technique. It is from the above that the possibilities of using X-ray diffraction as the broad tool to determine graphitic carbon content are presented.

Results and Discussion

The flexibility of the X-ray technique can best be described by examining the shape of the (002) diffraction peak, Fig. 1, for sample No. 1, consisting of a mechanical mixture of 87 per cent amorphous carbon and 13 per cent graphitized carbon (itself not com-

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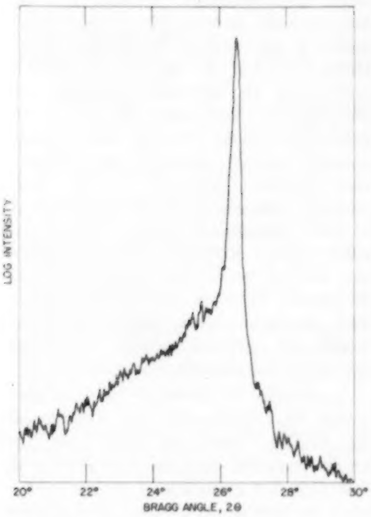

Fig. 1—X-ray Diffraction Pattern of the (002) Region for a Mechanical Mixture of Amorphous Carbon and Graphitized Carbon (Sample 1)—Cu Radiation.

pletely graphitic). The experimental X-ray diffraction techniques and discussion of the significance of the different carbon diffraction peaks are completely discussed elsewhere.[7] The (002) region consists of the superposition of the broad and weak (mechanically mixed) amorphous carbon peak, particularly on the low angle side, onto the sharp and strong peak of the graphitized carbon. From the angular location of the stronger peak, the interlayer spacing of the graphitized carbon is calculated to be 3.3600 Å at 15 C (again see the earlier paper[6] for techniques used to determine accurate interlayer spacings). Using the Franklin[2] and Bacon[8] correlation relating interlayer spacing to graphitic carbon content (reproduced in Fig. 2), the graphitized carbon is estimated to contain 80 per cent graphitic carbon.

Determination of the interlayer spacing of the carbon producing the weaker peak, seen in Fig. 1, is complicated by the difficulty of selecting the position of maximum peak intensity. However, if the main information desired is whether the weaker peak originates from amorphous carbon or semi-graphitic carbon, an approximation of its peak width at half peak intensity should be made. If this width is greater than 0.5 deg, using copper radiation (that is, the carbon has an average crystallite size of less than 150 Å,)[7,9] the carbon can be considered as amorphous.[10] If the width is less than 0.5 deg, an estimation of the angle at maximum peak intensity must be made to determine the graphitic carbon content. In sample No. 1, the width of the weak peak at half intensity approximates 4 deg, bearing out the amorphous character of this carbon.

In summary, the following information about the above carbon is obtained from Fig. 1:

1. The superposition of two (002) peaks indicates that the sample is a mechanical mixture of two carbons.

2. One of the carbons is amorphous; the other is 80 per cent graphitic.

3. The over-all sample, therefore, contains 90 per cent amorphous carbon, 87 per cent as discrete amorphous particles, and 3 per cent as amorphous carbon intimately mixed on a microscopic scale[2] with the 10 per cent graphitic carbon.

X-ray diffraction does not enable a determination of the percentage of mechanically mixed amorphous carbon in the above sample unless prior calibration runs have been made relating intensity of the peaks to different known amounts of the particular amorphous carbon in the particular graphitized carbon.

It should also be pointed out that the above information on a carbon, from preparation of an X-ray slide to interpretation of the data, can be obtained within 1 hr.

X-ray diffraction has been further used to clarify the proposed ASTM "float and sink" technique. A sample of the above carbon was ground to pass a No. 325 sieve, separated by centrifuging in ethylene bromide (directions of the ASTM test being carefully followed) and patterns taken of the top and bottom material, as shown in Fig. 3. As would be expected, the relative intensity of the amorphous carbon peak of the top material and that of graphitic carbon in the bottom material are found to be increased. However, it is noted that the top material still contains some graphitic carbon and the bottom material some amorphous carbon. From its X-ray parameters, the graphitic carbon is calculated to have a true density of 2.25. If the number of blind pores in the sample is small, the specific gravity will also approximate this figure, and all of the graphitic carbon should have settled to the bottom of the ethylene bromide. A substantial number of blind pores in the carbon particles would explain the floating of graphitic carbon as would also a preponderance of amorphous carbon in the individual particle.

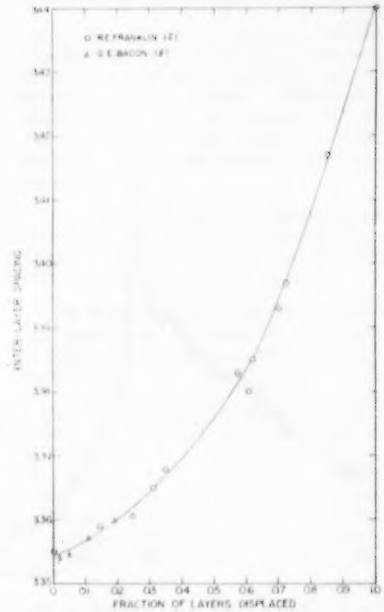

Fig. 2.—Variation of Mean Interlayer Spacing with Proportion, p, of Graphite Layers.

Table I presents comparable data on the graphitic carbon content of a series of carbons as determined by the techniques just discussed. An indication of the effect of particle size on the graphitic carbon content, as determined by the ASTM procedure, was determined on sample No. 1. It is seen that a decrease in particle size of the carbon resulted in a decrease in the amount of material floating on the ethylene bromide (called amorphous carbon by definition). This result could also be attributed to a decrease in the number of blind pores per particle upon finer grinding. Furthermore,

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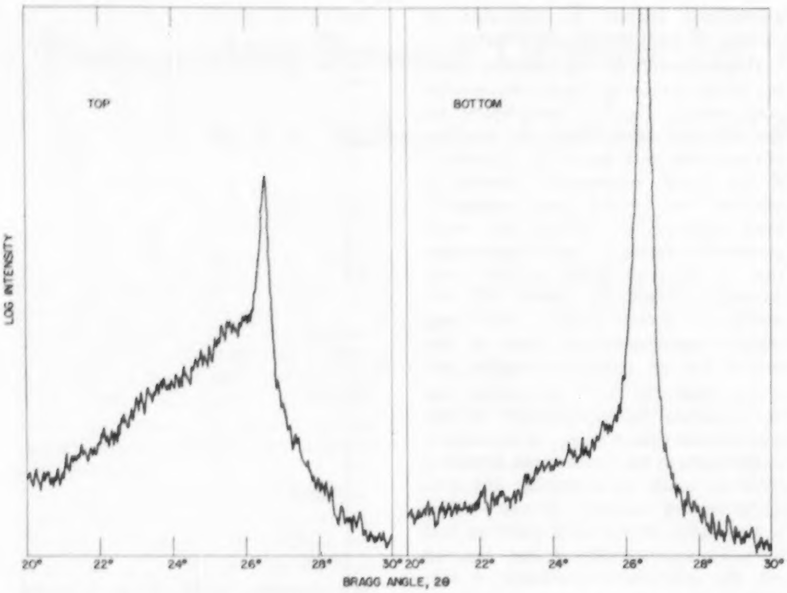

Fig. 3.—X-ray Diffraction Pattern of the (002) Region of Top and Bottom Material after Separation by ASTM Float and Sink Test (Sample 1)—Cu Radiation.

the graphitic content of these samples, as determined by the ASTM procedure,[6] is higher than that reported by X-ray diffraction. Since only 13 per cent graphitic carbon was added to this carbon, it is obvious that some of the amorphous carbon sank to the bottom of the ethylene bromide. This is confirmed in Fig. 3. It may be assumed that it was carried down by graphitic carbon.

Ceylon natural graphite was found to be 100 per cent graphitic by both techniques.

Again, for the spectroscopic, graphitized carbons, samples Nos. 3 and 4, and the graphitized carbon, sample No. 5, the ASTM procedure indicates a higher graphitic carbon content than does X-ray diffraction. If the amorphous material was microscopically dispersed among the graphitic material, as is supposedly the case, the "float and sink" procedure should have indicated 100 per cent graphite in all three cases. That this is not so for two of the samples perhaps indicates that the specific gravity of a portion of the particles was less than that of the ethylene bromide. Again blind pores within the particles, even after grinding to pass a No. 325 sieve, could be responsible.

For the petroleum coke sample No. 6, which was gas baked at only 1000 C and should be completely amorphous after this mild heat treatment, as confirmed by X-ray diffraction, the ASTM test indicates over 4 per cent graphitized carbon. It is barely possible that the 0.24 per cent ash in the sample was so distributed between particles that the resulting specific gravity of a fraction of the particles was greater than that of ethylene bromide (2.18).

On samples Nos. 5 and 6 the graphitic carbon content has also been determined by the graphitic acid test. It is seen that in both cases it gives a value intermediate between the X-ray diffraction and the "float and sink" test.

A further revealing comparison of the two techniques is found in testing the carbons produced from carbon monoxide decomposition. Carbon 7 is an intermediate carbon, 53 per cent graphitic, as indicated by X-ray diffraction. However, all of the carbon sank to the bottom of the ethylene bromide, indicating by this test 100 per cent graphitic carbon. On the other hand, another sample, which X-ray diffraction indicates possesses 15 per cent graphitic material, floated to the top of the ethylene bromide. These results clearly confirm the fact that the ASTM procedure is not able to distinguish between amorphous carbon and graphite when these two materials are present within the same crystallite or particle.

According to Seeley,[11] one of the things that prompted the writing of the ASTM "float and sink" test for graphitic carbon was the desirability of detecting the presence of carbon additions to natural graphite. The above test probably would be successful in detecting the presence of amorphous carbon if complete dispersion were achieved in the ethylene bromide. However, if carbon produced from carbon monoxide were substituted for a portion of the natural graphite, it would not be detected by the "float and sink" test. On the other hand, X-ray diffraction would show a doublet (002) peak and thereby indicate dilution of the graphite with a carbon of intermediate character.

Acknowledgment:

The authors wish to express their thanks to S. B. Seeley for his interest and advice regarding the presentation of this work.

This work was performed under Contract No. AT(30-1)-1710 of the U.S. Atomic Energy Commission.

TABLE I.—GRAPHITIC CONTENT OF DIFFERENT CARBONS.

Sample	Description	Passing Sieve	Interlayer Spacing at 15 C, Å	Graphitic Carbon Content, per cent		
				X-ray Diffraction[3]	ASTM "Float and Sink" Test[5]	Graphitic Acid Test[6]
No. 1a..	Mixture of 87 per cent petroleum coke and 13 per cent graphitized petroleum coke	No. 48	3.456—87% 3.3600—13%	10	24.4	...
No. 1b..	Repeat of 1a	...	....	10	28.9	...
No. 1c..	......	No. 325	....	10	36.5	...
No. 1d..	Repeat of 1c	...	....	10	37.6	...
No. 2...	Ceylon natural graphite	No. 325	3.3546	100	100	...
No. 3...	Spectroscopic graphitized petroleum coke powder	No. 325	3.3572	89	92.5	...
No. 4...	Spectroscopic graphitized petroleum coke, coal tar pitch rod	No. 325	3.3572	89	100	...
No. 5...	Graphitized petroleum coke, coal tar pitch rod	No. 325	3.3600	80	98.6	91.3
No. 6...	Petroleum coke, coal tar pitch rod	No. 325	3.456	0	4.3	0.30 0.54
No. 7a..	Carbon from CO decomposition	No. 200	3.374	53	100	...
No. 7b..	.....	No. 325	3.374	53	100	...
No. 8...	Carbon from CO decomposition	No. 325	3.416	15	0	...

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Henry C. Ashley, formerly Metallurgical Engineer, has been made Assistant Director of Metallurgy, Chase Brass and Copper Co., Inc., Waterbury, Conn.

Fred W. Barlow, until recently associated with Godfrey L. Cabot, Inc., Boston, Mass., is now Laboratory Manager, Thermatomic Carbon Co., Sterlington, La.

R. S. Barnett, formerly Technical Service Assistant, has been promoted to Technical Service Associate at Beacon Laboratories, The Texas Co., Beacon, N. Y.

Cecil J. Bier, formerly with Sylvania Electric Products, Inc., Bayside, N. Y., is now with General Electric Co., Knolls Atomic Power Lab., Materials Engineering Section.

Charles W. Blacketer has accepted a position as Technical Director, The McMurtry Manufacturing Co., Denver, Colo. He had been associated previously with Kwal Paints, Inc., of the same city.

Porter H. Brace, whose scientific curiosity helped find the key to mass uranium production, has ended an outstanding career with Westinghouse Electric Corp., Pittsburgh, Pa., after 42 years of service. Joining Westinghouse Research Laboratories in 1913, he was head of the Metallurgical Department from 1923 to 1936, when he was appointed Consulting Metallurgist. Although Mr. Brace might be inclined to minimize his own accomplishments, a Presidential Certificate of Merit, among other laurels, testifies to a richly productive scientific career. One of his most outstanding achievements took place about 1920, when he devised a brilliantly simple method of producing pure calcium. Rated a significant contribution to the field of metals technology at the time, the Brace process for pure calcium subsequently became a crucial factor in the mass production of uranium. In ASTM, Mr. Brace has been very active for many years in Committee B-4 on Metals for Electrical Heating, Electrical Resistance, and Electronic Applications. He also has served on Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, and on the Joint Committee on Effect of Temperature on Metals.

Wallace R. Brode, Associate Director for Chemistry, National Bureau of Standards, Washington, D. C., received the honorary degree of doctor of science at Whitman College.

John F. Broeker, Sales Promotion Manager of White Pigments for the Pigments Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., retired after 35 years with the company. Engaged in research, production, and sales of pigments through the years, he had been associated with the development of titanium dioxide pigments widely used in paints, linoleum, paper, ink, rubber, and plastics. Affiliated with many technical and scientific organizations, Mr. Broeker had been very active in ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products, and many of its subgroups for the past 20 years.

A. F. Burbidge recently retired as Principal Testing Engineer of Philadelphia Public Works Water Department. He now resides at 6249 Dartmouth Ave., N., St. Petersburg, Fla. Mr. Burbidge has been very active for many years on several ASTM technical committees including C-4 on Clay Pipe, C-9 on Concrete and Concrete Aggregates, C-15 on Manufactured Masonry Units, and D-4 on Road and Paving Materials.

C. O. Christenson, formerly Director, Technical Services, National Association of Home Builders, Washington, D. C., is now Technical Director, Acme Building Materials, Inc., Indianapolis, Ind.

E. B. Curtis, Assistant to Vice-President, R. T. Vanderbilt Co., Inc., New York City, retired recently after many years of service with the company. Mr. Curtis had represented the Vanderbilt Co. in the Society since 1937 and on Committee D-11 on Rubber and Rubber-Like Materials.

Maurice J. Day, Director of Research and Development, Crucible Steel Co. of America, Pittsburgh, Pa., was one of eight outstanding American engineers to receive a special Centennial Citation and Award from Michigan State College. Dr. Day was honored specifically "for his years of service in the field of metallurgical research and development" and for "distinguished contributions both to the theory and the practice of metallurgy."

Norman L. Deuble has had his title changed by Climax Molybdenum Co., New York City, from manager of metallic molybdenum sales to manager of the newly created metallurgical development division. Since joining Climax Molybdenum in 1947 Mr. Deuble has won wide recognition as an authority on the development of metallic molybdenum produced by the arc-casting process, working closely with users of these materials in the electronics and high-temperature fields.

J. D. Dickerson has been appointed to the staff of the central operating department of Crucible Steel Co. of America with headquarters in Pittsburgh, Pa.

C. S. Walton, former Staff Metallurgist, has been named to succeed Mr. Dickerson as Chief Metallurgist at Midland (Pa.) Works.

Lars E. Ekholm has been appointed Manager of the Sales Division of Climax Molybdenum Co., New York City. Mr. Ekholm has been associated with Climax Molybdenum since 1946, having held several executive positions in the sales department including the direction of foreign sales.

Claude E. Emmons has retired as Regional Manager, The Texas Co., Los Angeles, Calif. Mr. Emmons is a Past Officer and currently an active member of the ASTM Southern California District Council. He also has served for many years on Committee D-2 on Petroleum Products and Lubricants.

Norbert L. Enrick, recently appointed head of the Statistical Quality Control Dept., Institute of Textile Technology, Charlottesville, Va., is author of a book *Quality Control Through Statistical Methods Specifically Designed for Textile Mill* published by Rayon Publishing Corp., New York. His earlier book *Quality Control,* published by The Industrial Press, has come out in a new revised and enlarged edition.

The following were among 15 ASME members recently honored by election to the grade of Fellow of the Society: **Vivian F. Estcourt,** General Superintendent of Steam Generation, Pacific Gas and Electric Co., San Francisco; **John P. Magos,** Director of Engineering and Research, Crane Co., Chicago, Ill.; and **David Nabow,** Vice-President and Chief Engineer, Duke Power Co., Charlotte, N. C.

Simon Feigenbaum is now Chief Industrial Engineer for Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Arthur J. Fernandez has accepted the position of Quality Engineer at V-M Corp., Benton Harbor, Mich. He formerly was with R.B.M. Division of Essex Wire Corp., Logansport, Ind.

Arno C. Fieldner, dean of government research scientists and internationally known authority on coal and related fuels, retired from the Bureau of Mines, after more than 48 years of federal service. After his graduation in chemical engineer-

(*Continued on page 58*)

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Professional Cards continued on next page

Personals

(*Continued from page 55*)

ing from Ohio State in 1906 he spent a short time in private industry, then joined the U. S. Geological Survey at Pittsburgh. He transferred to the Bureau of Mines upon its creation in 1910, and is the oldest member in point of service. He headed fuel chemistry research in Pittsburgh, then during World War I headed a gas mask investigation unit which later became part of the Chemical Warfare Service. In 1927 he went to Washington as Supervisor of Experiment Stations. In 1936 he became Chief of the Technologic Branch, and directed research and development work on mining, metallurgy, and fuels and explosives. When the Fuels and Explosives Service (now Divisions of Solid Fuel, and Petroleum and Natural Gas) was created in 1942, he was named its chief. In 1950 he was appointed Chief Fuels Technologist, and last year he was made a Staff Adviser. A Past-President and Honorary Member of ASTM, Dr. Fieldner has been very active in both administrative and technical phases of the Society's work, his most intensive technical work being concentrated in Committee D-5 on Coal and Coke where he served as chairman for 28 years. He also served as first chairman of Committee D-3 on Gaseous Fuels.

Franklin H. Fowler, Jr., formerly with the Engineering Research Associates Division of Remington Rand, Inc., Washington, D. C., is now Professional Engineer, Digital Computers, Radio Corporation of America, Camden, N. J.

M. P. Getting, Jr., Assistant to Works Manager, Allis-Chalmers Manufacturing Co., Pittsburgh, Pa., has been appointed Assistant to the General Manager. Mr. Getting's successor is **George Shomberg Jr.,** who has been Assistant Superintendent, Electrical Test Dept.

Childress B. Gwyn, Jr., joined the General Plate Division of Metals and Controls Corp., Attleboro, Mass. For the past ten years he had been General Manager and Chief Engineer, Tungsten Sintered Metals Div., H. A. Wilson Co., Newark, N. J.

Ralph M. Hardgrove, Research Consultant, The Babcock & Wilcox Co., Alliance, Ohio, was 1955 recipient of the Benjamin G. Lamme Medal of Ohio State University, one of the university's top awards.

Oliver M. Hayden, Assistant Director of Sales, Rubber Chemicals Division at du Pont Co., was awarded the honorary degree of doctor of science by Clark University. He was recognized for his work in performance testing of rubber and in the development and testing of synthetic rubber products. Mr. Hayden received an ASTM Award of Merit in 1954 in recognition of notable contributions to ASTM work on rubber and rubber-like materials, and for sustained leadership in the technical and administrative activities of Committee D-11.

E. E. Howe has been named Vice-President of the Chicago Vitreous Corp., Cicero, Ill. Joining the company in 1934, he has served in various research and development capacities over the years. In 1942 he was appointed Chief Metallurgist and as such played an important part in the company's Armor Plate program during the war. In 1946 he was appointed Assistant Director of Research, and in 1951 became Director of Research, in which capacity he will continue to serve. In ASTM he represents the company membership and serves on Committee C-22 on Porcelain Enamel.

Henry J. Jacobson, formerly Chief Inspector, Grand Sheet Metal Products Co., Melrose Park, Ill., is now Quality Control Manager, Schaible Co., Mariemount Plant, Cincinnati, Ohio.

(*Continued on page 60*)

Personals

(Continued from page 58)

L. W. Kattelle has retired as Assistant Chief Engineer, Walworth Co., New York City. Representative of the Sustaining Membership of his company, Mr. Kattelle served on Committees A-1 on Steel, A-3 on Cast Iron, and A-7 on Malleable-Iron Castings.

Marvin L. Kaufmann recently joined Pioneer Tool Engineering, Inc., El Segundo, Calif., as Assistant to the President, and is Manager of two wholly-owned subsidiaries, the Consolidated Casting Co. and Republic Smelting and Refining Co. For 21 years he had been associated with U. S. Reduction Co., East Chicago, Ind., the last 13 as Vice-President of Operations.

Charles L. Kent has been appointed Assistant Director, Sales Technical Services, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

A. B. Kinzel, Vice-President, Research, Union Carbide & Carbon Research Laboratories, Inc., New York City, has been appointed for an additional three years to the Naval Research Advisory Committee.

Norbert K. Koebel has been made Manager, Heat Treating Furnace Div., Lindberg Engineering Co., Chicago, Ill. In addition to directing research and development, he will supervise technical sales, application engineering of heat treating processes and equipment, and will be chief technical adviser to associate companies in Europe and the Orient.

Warren J. Kunz, formerly Supervisor, Plymouth Cordage Co., Paper Twisting Div., Plymouth, Mass., is now Supervisor, Project Engineering, Aero Box Co., New Bedford, Mass.

C. P. Larrabee, Applied Research Laboratory, United States Steel Corp., Monroeville, Pa., has been named chairman of the Technical Practices Committee of the National Association of Corrosion Engineers. In ASTM, Mr. Larrabee has been very active in a number of the ferrous and non-ferrous groups. He currently serves as secretary of A-5 on Corrosion of Iron and Steel, chairman of Subcommittee XIV on Sheet Tests, also heads Subcommittee VII on Weather of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, and is a member-at-large of the Advisory Committee on Corrosion.

Harry Levin, former Supervisor, Analytical and Testing Dept., Beacon Labs., The Texas Co., Beacon, N. Y., has been promoted to Assistant to the Manager, Research Division, Beacon, N. Y.

D. W. Lewis, formerly Research Engineer, Indiana Joint Highway Research Project, and Associate Professor of Highway Engineering, Purdue University, has joined the National Slag Assn. Washington, D. C., as Chief Engineer. He will serve the Association principally on matters of an engineering nature involving slag as a mineral aggregate and its end uses, working closely with **E. W. Bauman,** Managing Director.

Carl J. Liebau was recently elected President, Federal Malleable Co., West Allis, Wis., succeeding the late W. H. Heatley. Mr. Liebau, who also will serve as Treasurer, became Vice-President in 1934, and Executive Vice-President in 1945. He is currently President of the Malleable Founders' Society.

James R. Long, formerly on the Metallurgical Advisory Board, National Academy of Sciences, Washington, D. C., is now Metallurgist with Harvey Machine Co., Torrance, Calif.

V. E. Lysaght, recently appointed General Sales Manager of American Chain & Cable Co., New York City, and well-known authority on the hardness testing of metals, was a featured speaker at the Second International Conference on Hardness Testing this month at Bremen, Germany.

Arthur R. Lytle has been appointed Vice-President in Charge of Research for Electro Metallurgical Co., a division of Union Carbide and Carbon Corp., New York City, succeeding A. B. Kinzel. Joining the Research Laboratories of the Corporation at Niagara Falls, N. Y., in 1923, he became head of the welding department in 1946, subsequently Assistant Manager of Research, and in 1952 moved to the New York office to occupy the post of Director of Research for the Electro Metallurgical Co.

Leonard I. Meisel, Supervisor of Plastics Branch of Naval Air Experimental Station, Philadelphia, Pa., will receive specialized training in federal management operations in Washington, D. C., including work under a Durham-Devor fellowship in public administration at American University.

Howard G. Minckler, formerly with Miller-Warden Associates, has accepted a position with Alexander Construction Co., Inc., Pleasantville, N. J.

John B. Morgan, until recently with A. M. Kinney, Inc., Cincinnati, Ohio, is now Designer Detailer, Sverdrup & Parcel, Inc., St. Louis, Mo.

E. P. Newhard has retired as Vice-President, Penn-Dixie Cement Corp., Nazareth, Pa. Mr. Newhard has served for a number of years on Committee C-1 on Cement.

Edward J. Nunan, Materials Engineer and Sales Manager, The Buffalo Slag Co., Buffalo, N. Y., has been named "Engineer of the Year" by the Erie County Chapter of the New York State Society of Professional Engineers. He is a former president of the chaper and a past-president of the state Society.

(Continued on page 63)

Personals

(*Continued from page 60*)

Philip V. Palmquist has been promoted to Technical Director of the Reflective Products Division of Minnesota Mining & Manufacturing Co., St. Paul, Minn.

J. H. Phillips, formerly Chief Chemist, The Babcock & Wilcox Co., Alliance, Ohio, is now Director of Engineering Research, National Aluminate Corp., Chicago, Ill.

Carl B. Post, Head of the Metallurgical and Research Departments at Carpenter Steel Co., Reading, Pa., has been promoted to Vice-President of Metallurgy. Dr. Post is known nationally for his research and contributions in the fields of automotive and aircraft valve steels.

John A. Rassenfoss, formerly Assistant Research Director, American Steel Foundries, East Chicago, Ind., has been appointed Manager of the Manufacturing Research Laboratory, a consolidation of the former research laboratory and the process development department.

Frederick D. Rossini, Head of Chemistry, Carnegie Institute of Technology, Pittsburgh, Pa., was Chairman of the National Academy of Sciences Research Council delegates at the fourteenth International Congress of Pure and Applied Chemistry meeting in Zurich, Switzerland, in July. He also was selected by the U. S. Department of State as chairman of the official United States delegation to the eighteenth Conference of the International Union of Pure and Applied Chemistry, held simultaneously in Zurich, **Wallace R. Brode,** of the National Bureau of Standards, was among five other delegates to the International Union Conference.

Everett J. Rutan, formerly Vice-President, Shaw-Rutan, Inc., New York City, is now Electrical Engineer, Brookhaven National Laboratory, Upton, N. Y.

B. E. Schaar recently retired as President, Schaar and Co., Chicago, Ill. Mr. Schaar was founder of the company which under his leadership since 1909 has become nationally recognized as suppliers of chemical laboratory equipment. He will continue to serve as a director, and will be succeeded as President by C. E. Schaar. The company will now be represented in ASTM by **L. A. Rauch,** Executive Vice-President.

Richard A. Schaus has been appointed Manager of Induction and Miscellaneous Equipment Engineering, Industrial Heating Dept., General Electric Co., Schenectady, N. Y. Mr. Schaus recently had been engaged in reactor development at the company's Knolls Atomic Power Laboratory.

Benjamin F. Shepherd, Chief Metallurgist, Ingersoll-Rand Co., Phillipsburg, N. J., received an honorary degree from Lafayette College.

(*Continued on page 64*)

(*Continued from page 63*)

Charles H. Smith, formerly with Kurfees Paint Co., Louisville, Ky., is now Special Representative, Chemical Div., The Goodyear Tire and Rubber Co., Philadelphia, Pa.

David Swan was made Director of Research-Metals, Electro Metallurgical Co., a division of Union Carbide & Carbon Corp., Niagara Falls, N. Y.

George N. Thompson recently retired as Assistant Chief, Building Technology Division, National Bureau of Standards, Washington, D. C., after many years of service. A longtime active ASTM member, Mr. Thompson was one of eleven honored by presentation of ASTM Awards of Merit at the recent Annual Meeting. Mr. Thompson was particularly recognized for distinguished contributions in Committee E-5 on Fire Tests of Materials and Construction, and his interest in building code standards. (See July, 1955 ASTM BULLETIN.) Mr. Thompson resides at 3717 S St., N. W., Washington 7, D. C.

Everett R. Turner, formerly Assistant to Works Manager, Dominion Tar and Chemical Co., Ltd., Cornwall, Canada, is now Metallurgical Supervisor, Research and Development Dept., Canadian National Railways, Montreal.

Helmut Wakeham, formerly Associate Director, has been appointed Director of Research at Textile Research Inst., Princeton, N. J.

Frederic D. Weekes, until recently with Henry A. Gardner Laboratory, Inc., Bethesda, Md., has accepted a position with Melpar, Inc., Division of Westinghouse Air Brake Co., Alexandria, Va.

R. E. Whinrey, General Manager, Link-Belt Co., Indianapolis, Ind., was elected a Director of the Malleable Founders' Society.

Leon J. Wise, Vice-President, Chicago Malleable Castings Co., Chicago, Ill., was named Vice-President of the Malleable Founders' Society at its recent annual meeting.

George W. Zink has retired as Assistant Engineer, Habirshaw Cable and Wire Division, Phelps Dodge Copper Products Corp., Yonkers, N. Y. Mr. Zink represented his company for many years in the Society and on Committees B-1 on Wires for Electrical Conductors and D-11 on Rubber and Rubber-Like Materials. He will be succeeded in the Society and Committee representation by **E. G. Driscoll.**

NEW MEMBERS . . .

The following 114 members were elected from June 22 to August 16, 1955, making the total membership 7984. . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals. Your ASTM Year Book shows the areas covered by the respective Districts.

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McConnaughay, K. E., 424 Columbia St., Lafayette, Ind.
Portable Electric Tools, Inc., E. C. Dudek, Chief Engineer, 340 W. 83rd St., Chicago 20, Ill.
Bajor, Michael J., Metallurgical Engineer, Inland Steel Co., 38 S. Dearborn St., Chicago 3, Ill.
Boller, Kenneth H., Engineer, U. S. Forest Service, Forest Products Lab., Madison 5, Wis.
Brower, Gilbert K., Project Engineer, Fuels and Lubricants, International Harvester Co., Advanced Engineering I.P.E.D., Melrose Park, Ill.
Brown, Owen E., Assistant Manager, Marquette Cement Manufacturing Co., Box 1377, 52nd and Park Ave., Des Moines, Iowa.
Rauch, L. A., Executive Vice-President, Schaar and Co., 754 W. Lexington St., Chicago 7, Ill.
Ulland, Eugene P., Vice-President and Chief Engineer, Ulland Brothers, Inc., Box 549, Austin, Minn. For mail: 1705 Oak Ridge Dr., Austin, Minn.

CLEVELAND DISTRICT

Raudebaugh, M. S., Sr., Chief Engineer, Macomber, Inc., 1925 10th St., N. E., Canton, Ohio.
Weise, William H., Works Metallurgist, American Steel and Wire Division, United States Steel Corp., 2650 Broadway Ave., Cleveland 13, Ohio.

DETROIT DISTRICT

Hambley, W. A., Consulting Metallurgist, 1418 Pierce St., Birmingham, Mich.
Newton, Francis J., Manager, Standards and Laboratory Quality Control Dept., Ford Division, Ford Motor Co., Bay A-10 Driveway Garage, Dearborn Assembly Plant, Dearborn, Mich.
Snair, William H., Metallurgist, Great Lakes Steel Corp., Tecumseh Rd., Ecorse 29, Mich.

NEW ENGLAND DISTRICT

Daly, Benedict T., Analytical Chemist, Material Testing Lab., Public Works Dept., 105 Dorchester Ave., South Boston 27, Mass.
Dengler, Alfred T., Development Engineer, American Oil Products Co., 100 Washington St., Somerville 43, Mass.
Mageau, Rene P., Manager, Magnaflux Corp., 85 Burnside Ave., East Hartford 8, Conn.
Pinette, Roger G., Chief Chemist, New England Tape Co., Inc., 30 Tower St., Hudson, Mass.
Rafter, J. Richard, Development Engineer, Grinnell Corp., 260 West Exchange St., Providence 1, R. I.
Uva, Pasquale A., Laboratory Director, Production Chemist, Avon Sole Co., Box 785, Avon, Mass.
Thompson, Gordon M., Head, Research and Development, Amerotron, North Vassalboro, Me. For mail: 14 Arundel St., Andover, Mass.

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Aries, Robert S., Chemical Engineer, R. S. Aries and Associates, 270 Park Ave., New York 17, N. Y.
Chu, Ting Ye, Department of Civil Engineering, New York State University, New York 68, N. Y.
Colburn, Cleaveland F., Materials Engineer, Reaction Motors, Inc., Rockaway, N. J.
Friedman, Norman, Converter, Spectrum Fabrics Corp., 261 Fifth Ave., New York 16, N. Y.
Greer, David M., Chief Engineer, Greer Engineering Associates, 98 Greenwood Ave., Montclair, N. J.
Lutz, Godfrey, Director of Construction Research, Turner Construction Co., 420 Lexington Ave., New York 17, N. Y.
Marshall, Dwight, Assistant Manager, Metal Sales, St. Joseph Lead Co., 250 Park Ave., New York 17, N. Y.
Morris, Morton Dan, Eastern Representative, Soiltest, Inc., 4711 W. North Ave., Chicago, Ill. For mail: 545 Fifth Ave., New York 17, N. Y.
Nelson, Carl E., Civil Engineer, 953 73rd St., Brooklyn 28, N. Y. [J]*
Norris, Wayne C., Technical Dept., American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y.
Prophet, James, Jr., Head, Experimental Lab., Esso Standard Oil Co., Bayonne, N. J.
Saacke, Charles W., President, Commonwealth Oil Refining Co., Inc., 161 E. 42nd St., New York 17, N. Y.
Van Dien, J. Edward, Director, Applied Spectrochemical Laboratories, 36 Cumberland Rd., Glen Rock, N. J.

NORTHERN CALIFORNIA DISTRICT

Halvorsen, L. J., Standards Engineer, Union Oil Co., Rodeo, Calif.
Mentzer, W. C., General Manager, Engineering, United Air Lines, Inc., San Francisco International Airport, San Francisco, Calif.
Mitchell, Joseph V., Professor of Dentistry, College of Dentistry, University of California, U. C. Medical Center, San Francisco 22, Calif.

OHIO VALLEY DISTRICT

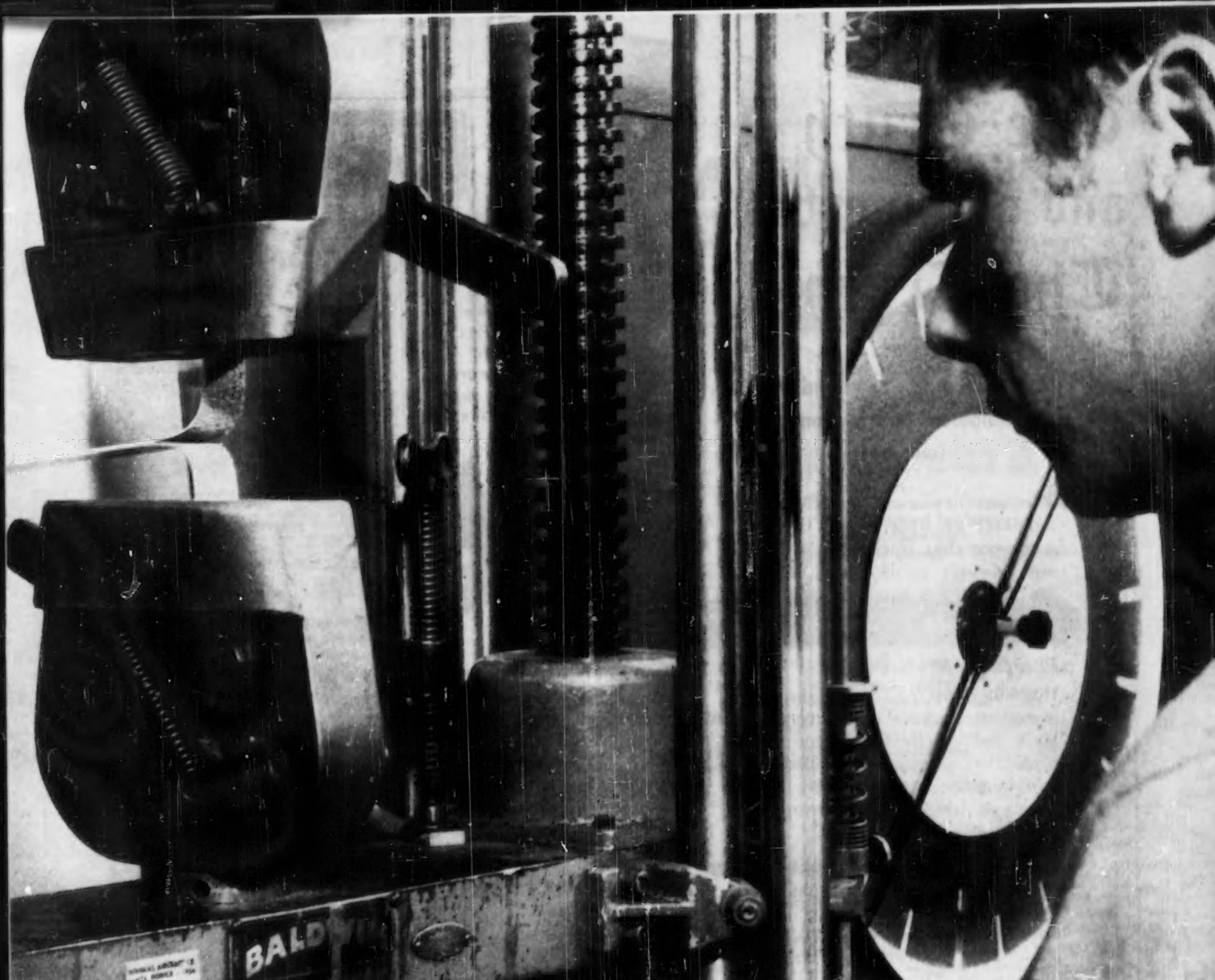
American Synthetic Rubber Corp., Fred J. Sackfield, Technical Director, Box 360, Louisville 1, Ky.
Dayton Rubber Co., The, Joseph Rockoff, Director of Research, W. Riverview Ave., Dayton 1, Ohio.
Baker, Robert F., Research Engineer and Lecturer, Ohio State University, Columbus 10, Ohio. For mail: 339 Piedmont Rd., Columbus 14, Ohio.
Hamstead, A. C., Process Development Dept., Carbide and Carbon Chemical Co., Division of Union Carbide and Carbon Corp., South Charleston, W. Va.
Sheery, John M., 101 N. Riley Rd., Muncie, Ind.

PHILADELPHIA DISTRICT

Expanded Clay and Shale Association, Inc., T. R. Berger, Executive Secretary, 522 Hamilton St., Allentown, Pa.

*[J] denotes Junior member.

(*Continued on page 67*)



TEAR TEST

New Members

(Continued from page 64)

Sprague & Henwood, Inc., Adrian E. Ross, President, Box 446, Scranton 2, Pa.

Ackerman, Carl F., Chemical Engineer, Union Mills Paper Manufacturing Co., New Hope, Pa.

American Scientific Glassblowers, The, J. Allen Alexander, President and Director, 309 Georgetown Ave., Gwinhurst, Wilmington 3, Del.

English, Wilton O., Plant Manager, Phoenix Manufacturing Co., Catasauqua, Pa.

Frankford Arsenal, Post Librarian, Bldg. 40 Basement, Philadelphia, 37, Pa.

Grottger, Miro A., Chief Chemist, Walker Brothers of Conshohocken, End St., Conshohocken, Pa.

Krech, K. G., Assistant Manager, Product Control Dept., The Atlantic Refining Co., Box 8138, Philadelphia 1, Pa.

Leckie-Ewing, P., Chief Metallurgist, Landis Machine Co., Waynesboro, Pa.

Sinnamon, Robert H., Development Engineer, Quaker Rubber Corp., State Rd. and Comly St. Philadelphia 24, Pa.

PITTSBURGH DISTRICT

Pennsylvania Transformer Co., M. L. Manning, Box 330, Canonsburg, Pa.

Surface Chemicals, Inc., Harry E. Rapp, Technical Director, 1101 Thompson Ave., McKees Rocks, Pa.

Bruckart, William L., Sales Engineer, Universal-Cyclops Steel Corp., Bridgeville, Pa.

Hensel, Robert P., Group Leader, Pittsburgh Consolidation Coal Co., Library, Pa. For mail: 139 Main St., Claysville, Pa.

Reeder, A. M., Metallurgical Engineer, Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.

Ruprecht, B. C., Chief Chemist, Harbison-Walker Refractories Co., Hays Lab., Pittsburgh 7, Pa.

Sturges, Frank Caleb, Vice-President and General Manager, Pennsylvania Drilling Co., 1205 Chartiers Ave., Pittsburgh 20, Pa.

ST. LOUIS DISTRICT

Alexander, J. C., Director of Research, ADCO, Inc., 900 W. Main, Sedalia, Mo. For mail: 1016 W. Broadway, Sedalia, Mo.

St. Louis Housing Authority, J. J. O'Toole, Executive Director, 901 Washington Ave., St. Louis, Mo.

SOUTHERN CALIFORNIA DISTRICT

Harvey Aluminum Co., G. A. Moudry, Chief Metallurgist, 19200 S. Western Ave., Torrance, Calif.

Czuha, Michael, Jr., Research Chemist, Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif. For mail: 5659 N. Noel Dr., Temple City, Calif.

Francis, Frank B., Metallurgical Engineer, Rome Cable Corp., 1739 213th St., Torrance, Calif.

Indermuehle, Lloyd R., Chief Chemist, Southwestern Portland Cement Co., 1034 Wilshire, Los Angeles, Calif. For mail: Box 937, Victorville, Calif.

SOUTHWEST DISTRICT

Texas-U. S. Chemical Co., T. A. McCoy, Manager, Box 1597, Port Neches, Tex.

Ballard, John W., Plant Superintendent, Bayou State Oil Corp., Box 1514 Shreveport, La. For mail: Route 1, Box 194, Vivian, La.

Newman, Robert J., Engineer, Bell Oil and Gas Co., Box 2007, Tulsa, Okla.

Schwarz, Walter J., Assistant to Vice-President, Building Materials Div., The Flintkote Co., 4500 N. Galvez, New Orleans 4, La.

WASHINGTON (D.C.) DISTRICT

Axilrod, Benjamin M., Physicist, Polymer Structure Section, National Bureau of Standards, Washington 25, D. C.

(Continued on page 69)

New Members

(*Continued from page 67*)

Chance, Walter R., President, Chance and Associates, 1715 Lee Highway, Arlington, Va.

Chapman, John J., Research Contract Director, The Johns Hopkins University, 1315 St. Paul St., Baltimore 2, Md.

Soper, Ellis C., President, Soper's Engineers, Franklin, N. C.

WESTERN NEW YORK—ONTARIO DISTRICT

Cox, W. J., Chief Stress Analysis Engineer, Massey-Harris-Ferguson, Ltd., Engineering Dept., 915 King St., W., Toronto, Ont., Canada.

UNITED STATES AND POSSESSIONS

Anderson Brass Works, Inc., R. L. Lock, Vice-President and Chief Engineer, P. O. Drawer 2151, Birmingham 1, Ala.

Berggren, Reynold G., Development Engineer, Oak Ridge National Laboratory, Box P, Oak Ridge, Tenn. For mail: 2021 W. Woodrow Ave., Knoxville 18, Tenn.

Christoferson, E. A., Technical Control, Scott Paper Co., Everett, Wash.

Clary, Robert B., Partner, Clary Engineering Co., Box 222, Lyons, Kans.

Foley, Frank D., Jr., Partner, The Concrete Co., Box 741, Columbus, Ga.

Innes, David, Corrosion Engineer, International Paper Co., Southern Kraft Div., Mobile 9, Ala.

Knudson, Melvin R., Manager, Wood Preservation Division, J. Neils Lumber Co., Libby, Mont.

Lawrence, Ray V., Chemist In Charge of Technical Section, U. S. Department of Agriculture, Naval Stores Division, Naval Stores Station Box 1, Olustee, Fla.

Linger, Don Albert, Instructor of Civil Engineering, New Mexico College of Agriculture and Mechanic Arts, State College, N. Mex.

Mitchell, Harry H., Engineer, Quality Control, Spartanburg Concrete Co., Box 1603, Spartanburg, S. C.

Nojima, Tetsuo Roy, Chief Assayer, Getchell Mine, Inc., Golconda, Nev.

Palmer, Kenneth E., Assistant Director of Research, Ideal Cement Co., Box 531, Fort Collins, Colo. For mail: 404 Edwards, Fort Collins, Colo.

Shaver, Paul D., Chief Architectural Engineer, United States Department of the Air Force, 7280th Air Instl. Sq., APO 30, New York, N. Y.

OTHER THAN U. S. POSSESSIONS

Accles & Pollock, Ltd., Walter Hackett, Jr., Managing Director, Paddock Works, Oldbury near Birmingham, England.

British Radio Valve Manufacturers' Assn., P. A. Fleming, Technical Secretary, Piccadilly House, 16 Jermyn St., London, S. W. 1, England.

Chemische Werke Hüls Aktiengesellschaft, W. Baumbach, Marl Kreis Recklinghausen, British Zone, Germany

Ciba, Ltd., Karl Frey, Manager, Basle, Switzerland.

Compania Tecnica de Construcciones S.A., Eudoro Cevallos, Civil Engineer, Box 1171, Guayaquil, Ecuador.

Inland Cement Co., Ltd., V. Chaly, Chief Chemist, 10330 104th St., Edmonton, Alberta, Canada.

L'Hoir, Inc., George C. L'Hoir, President, Box 190, Levis, P.Q., Canada.

Tata Locomotive and Engineering Co., Ltd. (TELCO), H. Korschan, General Manager of TELCO, Telco Works P.O., Jamshedpur -4, India.

Carlisle, Reginald C., Metallurgist, Canadian Ingersoll-Rand Co., Ltd., 375 Courcelette St., Sherbrooke, P.Q., Canada.

Coblans, Herbert, Head, Information Service, CERN, Bibliotheque, Case postale 25, Geneva 15, Aéroport, Switzerland.

Eisner, Karel, Drevarsky vyskumny ustav (Forest Products Research Inst.), cesta c.5, Bratislava, IX, Czechoslovakia.

(*Continued on page 70*)

New Members

(Continued from page 69)

Fouad I University, Faculty of Engineering, Orman Gardens, Giza B, Egypt.
Hofton, James, Technical Advisor, British Industrial Plastics, Ltd., Oldbury near Birmingham, England.
Hollihan, Thomas D., Plant Engineer, Ecuadorian Corp., Ltd., La Cemento Nacional, Casilla 103, Guayaquil, Ecuador.
Ignatieff, A., Chief, Division of Fuels, Mines Branch, Department of Mines and Technical Surveys, 562 Booth St., Ottawa, Ont., Canada.
Keshava, S. K., Assistant Chemist, Imperial Tobacco Company of India, Ltd., Box 89, Calcutta, 1, India.
Kredentser, H., Technical Administration Office, Sherwin-Williams Company of Canada, Ltd., Box 489 Montreal, P.Q., Canada.
Knox, Alex Charles, Engineer, Inspector, Associated Engineering (N.Z.), Ltd., Jellicoe Ave., Panmure, Auckland, New Zealand. [J]
Martin-Belmonte, Ignacio, Inspection Engineer, Laboratorio de Ensayo de Materiales, Universidad de la Habana, Havana, Cuba. For mail: Monte 60, Apartado 2153, Havana, Cuba.
Ram, Atma, Director, Central Glass and Ceramic Research Inst., P.O. Jadavpur College, Calcutta 32, India.
S.M.E. Servizio Tecnico Artiglieria, Ministero Difesa Esercito, Via Marsala 108, Rome, Italy.
Universidad de Nuevo Leon, Facultad de Ingenieria, Federico G. Tamex, Director of Engineering, Washington y c. Civil, Monterrey, N. L., Mexico.
Wellington, J. R., Research Engineer, The Consolidated Mining and Smelting Company of Canada, Ltd., Trail, B. C., Canada
Wiester, Hans-Joachim, Director, Mannesmann-Forschugsinstitute G.M.B.H, 22a Duisburg-Wanheim, Postfach, Western Germany. For mail: Bredeneyer Str. 143, 22a Essen-Bredeney, Western Germany.

DEATHS...

G. Worthen Agee, President, Barrow-Agee Laboratories, Inc., Memphis, Tenn. (July 25, 1955). Representative of company membership since 1924.

I. Arthur Anson, Vice-President in Charge of Refining, Bell Oil and Gas Co., Tulsa, Okla. (June 10, 1955). Member since 1948.

S. I. Aronovsky, of the United States Department of Agriculture, Northern Regional Research Laboratory, Peoria, Ill. (February 27, 1955). Member of Committee D-7 on Wood and its Subcommittee XIV on Methods of Chemical Analysis since 1953; also representative of the U. S. Northern Regional Research Laboratory on Committee D-23 on Cellulose and Cellulose Derivatives.

George C. Borden, Jr., Technical Director, Riegel Paper Corp., Milford, N. J. (July, 1955). Member since 1950 of Technical Committee M on Petroleum Wax of ASTM Committee D-2 on Petroleum Products and Lubricants (functioning as Joint Committee of TAPPI and ASTM), serving as chairman of this group for some time prior to his death.

W. F. Carter, Technical Director, Acme Steel Co., Chicago, Ill. (May 23, 1954). For many years representative of Acme Steel Sustaining membership, and member of Committee A-1 on Steel and its Subcommittee XIX on Sheet Steel and Steel Sheets.

Albert Edwards Cummings, Director of Research and a Director of Raymond Concrete Pile Co., New York City (July 20, 1955). A graduate of the University of Wisconsin, he had been associated with Raymond Concrete Pile Co. since 1916, serving in various capacities. He had taken an active part in the development and practical application of soil mechanics to foundation work, visiting soil mechanics laboratories in different parts of the world, and frequently serving as consultant on difficult foundation problems in this country and abroad. Affiliated with many technical and professional groups, he was a member of the Executive Committee of the International Society of Soil Mechanics and Foundation Engineering. Joining ASTM in 1936, Mr. Cummings had been very active through the years in Committee D-18 on Soils for Engineering Purposes, serving on many subgroups. At the time of his death he was chairman of Subcommittee R-11 on Pile Load Bearing Tests.

Walter H. Flood, Owner, Walter H. Flood and Co., Consulting Chemical Engineers, Chicago, Ill. (1951). Member since 1915.

Christopher Earle Loos, Assistant Metallurgical Engineer, Structural, Plate and High Strength Steels, United States Steel Corp., Pittsburgh, Pa. (July 30, 1955). A graduate of Lehigh University and member of Tau Beta Pi, Mr. Loos was associated with United States Steel for 40 years. He began his career with American Bridge Co. In 1939 he became Manager of the Structural and Plate Bureau of the then Carnegie-Illinois Steel Corp., and in 1947 Assistant Metallurgical Engineer, Structural, Plate and High-Strength Steels, the position he held until his death. In addition to ASTM, his society affiliations included the American Welding Society, American Society for Metals, and the American Railway Engineering Assn. Joining ASTM in 1940, he had been very active in Committee A-1 on Steel, serving for seven years as chairman of Subcommittee II on Structural Steel for Bridges, Buildings, Rolling Stock and Ships. In June of this year Mr. Loos was honored with an ASTM Award of Merit in recognition of "significant leadership in improving specification requirements for structural steels."

Harmon S. Meissner, Research Engineer, U. S. Bureau of Reclamation, Denver, Colo. (July 22, 1955). A member of the Society since 1939, Mr. Meissner had served for nine years on Committee C-1 on Cement and many of its subgroups; at the time of death he was chairman of the Working Committee on SO_3 Content. Since 1952 he had served as representative of ASTM on ASA Sectional Committee A 1 on Specifications and Methods of Test for Hydraulic Cements.

Cornelio Miechielsen, Mining and Civil Engineer, Tecnica Industrial, S.A., Monterrey, Mexico. Representative of company membership since 1946.

R. C. Parson, Chief Inspector, Robert W. Hunt Co., Birmingham, Ala. Representative of his company since 1945 on Committee A-3 on Cast Iron.

R. H. Patch, Vice-President and Treasurer, E. F. Houghton & Co., Philadelphia, Pa. (November 13, 1954). Representative of company membership since 1937.

Beauford H. Reeves, Vice-President and General Manager, Rockbestos Products Corp., New Haven, Conn. (April 1, 1955). Representative of company membership since 1934, also member of Committee D-13 on Textile Materials and several of its subcommittees for the same period.

P. C. Rogers, President and Treasurer, Quincy Steel Casting Co., Wollaston, Mass. (March 18, 1955). Member since 1926.

Harry J. Sheard, Refinery Manager, Bayou State Oil Corp., Shreveport, La. (April 9, 1955). Member since 1946.

E. Von Hambach, Research and Development Engineer, The Carpenter Steel Co., Reading, Pa. (August 11, 1955). Member since 1923. Associated with The Carpenter Co. for 27 years, Mr. Von Hambach was a nationally known pioneer in the development and fabrication of stainless steels. He was known by many in the industry as "Mr. Stainless." Other national organizations with which he was affiliated include the American Society of Tool Engineers, American Society for Metals, Engineering Society of Detroit, and the Air Force Assn.

Robert C. Woodward, until his retirement last year, Chief Metallurgist, Bucyrus-Erie Co., South Milwaukee, Wis., died April 20, 1955, at the age of 68. Mr. Woodward has been a very active member for 16 years of ASTM Committee A-1 on Steel, and its Subcommittees II on Structural Steel for Bridges, Buildings, Rolling Stock and Ships, and VIII on Steel Castings.

Charles D. Young, retired Pennsylvania Railroad Vice-President, and ASTM Past-President (May 13, 1955). (See accompanying article.)

CHARLES D. YOUNG

1879–1955

Charles D. Young, retired Pennsylvania Railroad Vice-President, and ASTM Past-President, died May 13, 1955, at his home, 1941 Panama St., Philadelphia, Pa., at the age of 76. A 1902 graduate of Cornell University,

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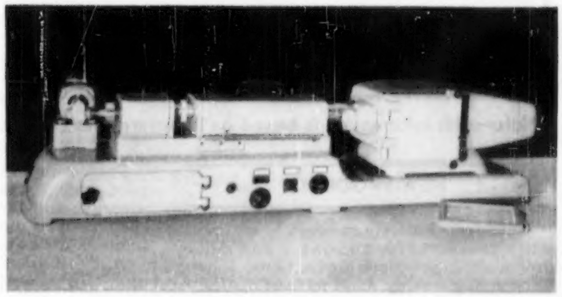

The Amsler Horizontal Tensile Testing Machine has been designed for testing materials of small section or low tensile strength such as fine wires, foils, fibers, fabrics, paper, yarn, leather, rubber, etc. The long horizontal design permits easy access to all parts, unobstructed view of the specimen, convenient gripping mechanisms and sufficient travel for specimens of great elongation such as rubber.

All of the desirable features in a small testing machine are included, such as the highly accurate pendulum load weighing system, five load ranges for greatest sensitivity at all loads, and speed control variable through eight steps from 0.1 to 20 inches per minute.

The tensile load applied is balanced by the deviation of the pendulum from the vertical position. The movement of the pendulum is indicated on a straight line scale located in front of the operator for easy reading. The pointer remains at the maximum load after fracture of the sample. The recording drum is located directly below the load scale. The recorder will plot the elongations as 1/5 size, actual size or double size.

A split nut arrangement on the pulling grip allows quick positioning of this grip to accommodate different length specimens. A wide variety of jaws and clamps are available for holding the different samples.

The Chevenard Micro Tensile Testing Machine has been designed for testing materials of very low strength or of micro dimensions. Samples with a breaking strength as low as one gram (0.035 oz.) may be tested. The machine, however, is extremely versatile having a maximum capacity of 100,000 times the minimum capacity of 100 kg. (220 lbs.). This broad range is obtained by the use of interchangeable dynamometer springs. The pulling speed can be varied between 6 and 300 mm. (0.24 and 12 in.) per minute. This is accomplished by the use of a variable speed motor and a sliding gear change box.

Two interchangeable optical tripods utilizing a light beam and photographic recording provide the utmost sensitivity in the measurement of elongation and the recording of stress-strain curves. Specimens can be tested dry or in a liquid bath and may be from 2 to 150 mm. (0.08 to 6.0 in.) between grips. The grips will accommodate specimens up to 6 mm. (0.24 in.) wide.

A micrometer and accessories are included for carrying out load-elongation cycles between two given values of elongation. The tester is also equipped with an automatic device for carrying out cycles between two given values of the load.

All of these features make the tester ideal for research or control tests on wire or thin metal strip, natural or artificial fibers and textiles, threads, tissues, paper, films of paint or varnish or similar materials.

Prompt delivery on these machines can be made from stock now in U. S. A.

AMSLER LINE OF PHYSICAL TESTING APPARATUS

Abrasion Testers	Dynamometers	Presses
Calibrators	Extensometers	Pulsators
Cement Testers	Gauge Testers	Tension Indicators
Chevenard Micro Testers	Hardness Testers	Torsion Testers
Creep Testers	Volume Meters	Vertical & Horizontal Tensile Testers of All Sizes
	Impact Testers	

ADOLPH I. BUEHLER METALLURGICAL LABORATORY APPARATUS

Colorimeters	Magnifiers	Spectrographs
Comparators	Metallographs	Titrators
Dilatometers	Microscopes	Wide Field Microscopes
Laboratory Furnaces	pH Meters	
Measuring Microscopes	Pyrometers	
	Refractometers	

Adolph I. Buehler

OPTICAL INSTRUMENTS

2120 GREENWOOD AVENUE, EVANSTON, ILLINOIS

Deaths

(*Continued from page 70*)

Mr. Young started his service with the railroad the same year. He advanced through positions as foremen, assistant master mechanic, assistant engineer of motive power, engineer of tests (Altoona, Pa.), and superintendent of motive power (Wilmington, Del.). In 1932 he was named vice-president for purchases, stores and insurance; in 1938 he became vice-president in charge of real estate, purchases, and insurance; and the following year he was elected a director.

His years in railroad service were interrupted twice—by World War I and World War II. During World War I he was commissioned a lieutenant colonel in the U. S. Army Engineers. During World War II he served with the rank of brigadier general as director of the procurement and distribution division, Army Services of Supply.

A long-time ASTM member, Mr. Young was elected a director of the Society in 1917; served as Vice-President 1917–1919, and President 1921–1922. In addition to aiding in administrative work, Mr. Young in his earlier years was very active in Committee A-1 on Steel, serving as chairman from 1913 to 1918; and in recognition of valued contributions he was elected to honorary membership in that group.

Associated with a number of other technical and professional organizations, Mr. Young served as a divisional chairman of the American Railway Assn., and was a trustee of Drexel Institute. Franklin Institute awarded him the Longstreth Medal of Merit for his work in developing locomotive superheaters, and the Henderson Medal for his contributions to scientific advancement in steam locomotives.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses

NEW PRODUCTS

Shielded Enclosures—Series of versatile enclosures for microwave and radio frequency interference applications.
Ace Engineering & Machine Co., Inc., 3644 North Lawrence St., Phila., 40, Pa.

Restrictor Valves—Series 1100 line of lightweight restrictor valves for 3000-psi hydraulic service.
Aircraft Products Co., 300 Church Rd., Bridgeport, Pa.

SR-4 Gages—Three new standard SR-4 bonded resistance wire strain gages with flat grid, fine pitch, and Bakelite base.
Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Thermistor Detectors—New thermistor detectors that can sense infrared radiation in as little as 2 milliseconds.
Barnes Engineering Co., 30 Commerce Road, Stamford, Conn.

Glass Electrodes—New type of pH-sensitive glass which will benefit both laboratory and process control users of pH equipment.
Beckman Instruments, Fullerton, Calif.

Air Compressor—New high capacity piston type air compressor radically new in design, delivers perfectly oil-free air, while delivering up to 175 psi pressure.
Bell & Gossett Co., Morton Grove, Ill.

Sound Detector—Listening device makes it possible to detect the smallest internal defects in moving machinery without shutting down or otherwise taking the equipment out of service.
Burke & Co., Worton, Md.

Electronic Spring Gage—Winstrom Electronic Gage for use on automatic spring coilers measures the tolerances on the free length of each spring as it is coiled and automatically accepts a correct spring and rejects and discards springs too short or too long.
The Carlson Co., 277 Broadway, New York 7, N. Y.

Pressure and Temperature Pilot—New pilot which is said to provide extremely accurate and dependable control and is the first of its kind to permit regulation of temperature as well as pressure.
A. W. Cash Co., P. O. Box 551, Decatur, Ill.

Clean Air—An improved design of compressed air separator which effectively cleans compressed air of water, oil, dirt, scale, cinders, and other elements.
Chicago Manufacturing and Distributing Co., 1928 West 46th St., Chicago 9, Ill.

Zytel—New line of Swagelok tube fittings made of zytel polyamide resin for plastic tubing where corrosion is a problem.
Crawford Fitting Co., 884 East 140th St., Cleveland 10, Ohio.

Nep Machine—Designed by the United States Department of Agriculture and written up in the USDA Bulletin of November 1954 titled, "Laboratory Equipment and Method for Making Nep Tests on Cotton Samples."
Custom Scientific Instruments, Inc., Kearny, N. J.

Transducers for Force, Weight, and Stress—New models have been added to the Daytronic Series 140 Load Transducers with full scale ranges now available from 5 lb to 100,000 lb.
Daytronic Corp., 216 South Main St., Dayton 2, Ohio.

Metal Mix-ups—New Model CE Cyclograph affords a rapid and inexpensive means of nondestructively testing and sorting accidentally mixed or incorrectly processed metal parts.
J. W. Dice Co., Englewood, N. J.

Thermometers Signal Guards—Visual and vivid warning signal which tells the operator, even from a distance of 50 ft, when normal temperature readings rise or fall.
W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Calif.

Dehumidifier—New adsorption type, heavy duty dehumidifier suitable for use in factories, warehouses, storage vaults, and other large areas where controlled humidity is desired.
Dryomatic Corporation, Alexandria Va.

Dynamic Flowmeter—For the accurate measurement of pulsating fluid flow, a revolutionary new flowmeter combining a head-type, flow-sensing element and a high frequency-response, force transducer.
Dynamic Instrument Co., Inc., 28 Carleton St., Cambridge, Mass.

Tri-X Reversal Film—High-speed Kodak Tri-X emulsion on 16-mm reversal film is expected to find immediate acceptance by industrial photographers because of the high speed and sensitivity which have been achieved without a corresponding increase in graininess.
Eastman Kodak Co., Rochester 4, N. Y.

Dekabridge—Besides having an extremely wide range, this new method of packaging increases the speed of making Wheatstone Bridge measurements and reduces the chance of human error.
Electro-Measurements, Inc., 4312 S. E. Stark St., Portland 15, Ore.

Grinder—Multiple head conveyor-type abrasive belt grinder designed for wet or dry grinding and polishing of ferrous, non-ferrous, plastic, and other materials.
The Engelberg Huller Co., 813 West Fayette St., Syracuse 4, N. Y.

Syte-Ayde—Inspection light sees around corners, gives magnified view of hard-to-see areas.
F. T. S. Corp., 309 Vine St., Camden 2, N. J.

Fluorographic Film Viewers—Two new 70-mm photo-fluorographic film viewers for mass radiography will permit the reading of a large number of negatives over a long period of time while reducing eye fatigue to a minimum.
Industrial Camera Division, Fairchild Camera and Instrument Corp., Syosset, N. Y.

(*Continued on page 74*)

Lab Supplies

(*Continued from page 72*)

Impedance Measurement—New Type 1603-A Z-Y Bridge possesses the almost unbelievable characteristic that it can be balanced for *any* impedance connected to its terminals. From short circuit to open circuit, real or imaginary, positive or negative, a bridge balance can be obtained with ease.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Safety Guard—Any table model circular saw can be made completely safe with revolutionary new gliding-action guard which lets user see all work operations clearly through transparent plastic shields.
General Scientific Equipment Co., 2700 W. Huntingdon St., Philadelphia 32, Pa.

Flexible Liner Pump—The toughest corrosive chemicals and abrasive slurries in industry are being effectively handled through a new type plastic-body pump, versatile enough to pump materials as dissimilar as hydrochloric acid and mayonnaise.
Vanton Pump and Equipment Corp., Hillside, N. J.

Oven for Drying Operations—A new addition to standard line of low-cost ovens for drying operations such as plastic granules, parts after cleaning, and loose materials that require dehydration.
Grieve-Hendry Co., 1401 W. Carroll Ave., Chicago 7, Ill.

Viscometer—High shear viscometer for testing the flow properties of pigment suspension in the manufacture of paper, as well as paints, printing inks.
Hagan Corp., 233 Fourth Ave., Pittsburgh 30, Pa.

Thermotrol—An extremely sensitive and accurate temperature controller that will completely alter the fundamental ideas of design of temperature-controlled baths, etc.
Hallikainen Instruments, 1341 Seventh St., Berkeley, Calif.

Shelv-it-all—Rugged all steel shelving units that hold up to 300 lb per shelf.
S. A. Hirsh Mfg. Co., 8051 Central Park Ave., Skokie, Ill.

Nuclear Moisture Meter—The solution of a long existing problem, namely, a means of determining soil moistures rapidly, accurately, and directly in the field without medium disturbance.
William B. Johnson & Associates, Inc., P. O. Box 514, Mt. Lakes, N. J.

Vacuum Gages—A Bennert-type manometer, for the determination of absolute pressures in the range of 0 to 240 mm.
Kontes Glass Co., Vineland, N. J.

Sink Trap—A new P-type polyethylene sink trap. In comparison with the earlier S-type sink traps which had interior junctions not visible from the outside, the new P-type trap is like ordinary metal traps in that one surface of all pipes can be seen from the exterior.
Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

Inclination Angle—An instrument for the determination of the inclination angle (Randwinkel) on metals and ores.
E. Leitz, Inc., 468 Fourth Ave., New York 16, N. Y.

Single-Actuated Dual Switch—Low-force, double-pole switch with the ability to switch two isolated circuits at the same time.
Minneapolis-Honeywell Regulator Co., Micro Switch Div., Freeport, Ill.

Magnetic Null Indicator—Portable measuring instrument as much as 100 times faster than moving coil type galvanometers has been developed for laboratory and production testing.
Minneapolis-Honeywell Regulator Co., Doelcam Div., 1400 Soldiers Field Rd., Boston 38, Mass.

Mutual Inductance Micrometer—This instrument, which has been tested by the National Bureau of Standards, measures the dynamic clearance of a rotating shaft, and thus indicates its eccentricities.
Minnesota Electronics Corp., 133 E. Santa Anita St., Burbank, Calif.

Three-Specimen Spectrograph—Three Specimen Inverted Spectrograph, designed so the X-ray beam strikes specimens from the bottom—for analysis of metals, powders, and liquids such as heavy waxes and oils.
North American Philips Co., Inc., Research & Control Instruments Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

Ore-Lube—Revolutionary scientifically developed and proven new lubricant.
Ore-Lube Co., 11 Front St., New York 4, N. Y.

Tack Cloth—Designed for easy removal of lint, dust, abrasive grain, metal, and paint particles in all finishing and refinishing operations.
Permacel Tape Corp., New Brunswick, N. J.

Filters—A new design and a sharply reduced price in Porous Teflon and Kel-F in-line filters.
Porous Plastic Filter Co., 30 Sea Cliff Ave., Glen Cove, N. Y.

Low Temperature Cabinet—Redesigned B.O.D. Incubator, now known as the "Dual Range" Low Temperature Cabinet. It has unique control system whereby the heater and cooling system cycle against each other at near-room temperatures, providing the new cabinet with two temperature ranges—a low range from 5 C above freezing to 5 C above room, and a high range from 5 C above room to 50 C.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Portable Oscilloscope—Smallest complete oscilloscope on the market, weighing only 8½ lb and taking up less that ½ ft on the bench.
The Probescope Co., of 44-05 30th Ave., Long Island City, N. Y.

Pressure Switch—Rugged construction features and a wide range of application.
Rochester Manufacturing Co., Rochester, N. Y.

Portable Pyrometer—A portable gadget that looks like a microphone on the end of a long pole has solved the problem of accurately measuring high temperatures of metals and refractories when surrounded by cooler air.
Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

Fraction Collector—A new fraction collector for chromatography. Collections can be made automatically by either the "Timed Flow" or the "Volumetric Method."
Schaar and Co., 754 West Lexington St., Chicago 7,.

Accelerator—A new, compact acceleration testing machine that tests and calibrates small assemblies while at the same time subjecting them to multiples of the acceleration of gravity.
Schaevitz Machine Works, Camden 1, N. J.

Water Demineralizer—Small capacity, quality built, water demineralizer for use in industrial laboratories where limited quantities of distilled water are used.
Scientific Equipment Corp., 5438 Lowell Ave., Indianapolis 19, Ind.

Adhesion—A simplified method of testing the adhesion of vulcanized rubber and similar elastomers to metal.
Scott Testers, Inc., 120 Blackstone St., Providence, R. I.

Portable Compression Tester—Lightweight compression tester that enables compression and crushing tests to be made quickly and easily.
Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill.

Pulse Transformer Kit—Engineering development assistance for pulse circuit designers is provided by a new Pulse Transformer Kit.
Sprague Electric Co., Marshall St., North Adams, Mass.

Miniature Pressure Transducers—Series of miniature pressure transducers, which employ the Statham unbonded strain gage, is available for the measurement of absolute, differential, and gage pressures.
Statham Laboratories, Inc., Los Angeles 65, Calif.

Talk-A-Phone—Utilizing newly developed principle of automation, the new Talk-A-Phone Super Chief system is operated automatically by your own voice, eliminating the necessity of either party manipulating any controls during the conversation.
Talk-A-Phone Co., 1512 S. Pulaski Rd., Chicago, Ill.

Dust Collector with Casters—All Torit dust collectors of both the cabinet and cyclone type are now available with casters as optional equipment.
Torit Mfg. Co., 287 Walnut St., St. Paul, Minn.

Small Part Concentricity—Developed to facilitate testing of its own servo components, this new portable bench center has found widely divergent uses for checking and machining tiny parts, measuring tool wear, chamfer angles, etc.
Transicoil Corp., Worcester, Montgomery Co., Pa.

Graphic Recorder—Portable, modestly-priced graphic recorder, capable of wide-spread applications in the recording of data.
Varian Associates, 611 Hansen Way, Palo Alto, Calif.

(*Continued on page 76*)

(Continued from page 74)

Laboratory Press—New four-post hydraulic laboratory press exerting 60,000-lb pressure.
Wabash Metal Products Co., 1571 Morris St., Wabash, Ind.

Stationary Compressor—New line of two-stage, air-cooled, electric-motor-driven compressors.
Le Roi Div., Westinghouse Air Brake Co., Milwaukee, Wis.

CATALOGS AND LITERATURE

Filter Driers—The 6 Point Protection offered by A-P Trap-Dri filter driers is described in a six-page, two-color bulletin.
A-P Controls Corp., 2450 N. 32nd St., Milwaukee, Wis.

Tape Recording Equipment—New, 16-page *Bulletin 103* describes and illustrates nine basic "Building Block" components and a series of accessories functionally designed to make up A-V Magnetic Tape Recording systems of from 2 to 14 channels for instrumentation data.
A-V Manufacturing Corp., 730 Fifth Ave., New York 19, N. Y.

Recording—The first edition of *Alfax News*, a publication which will appear at various times during the year when there is important news to be told.
Alfax Paper and Engineering Co., Alden Research Center, Westboro, Mass.

Protective Coatings—Information on 14 types of coatings used widely to protect equipment where fumes and industrial atmospheres cause corrosion.
The Atlas Mineral Products Co., Mertztown, Pa.

Spectrophotometer Brochure—Four-page *Bulletin 410*, describing Beckman's new automatic infrared spectrophotometer. The Model IR-2A described is a high-performance, low-cost instrument suited to both research and quantitative analysis. *Request Bulletin 410.*
Beckman Division, Beckman Instruments, Inc., Fullerton, Calif.

Leak Detector—New leak detector utilizing the radio-frequency mass spectrometer principle.
Beckman Division, Beckman Instruments, Inc., Fullerton 1, Calif. Request Bulletin 416.

Spectrograph—New model 3-Meter Concave Grating Spectrograph provides wavelength coverage in a single exposure which is double that of previous models. This new instrument can photograph more of the spectrum in one exposure, at high dispersion, than any other concave grating spectrograph commercially available.
Dept. S. N., Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass. Request Bulletin No. 52.

Throttltrol—*Bulletin F 5991-1* describes the Wheelco Throttltrol, an automatic valve positioner for use in conjunction with any control instrument having a "high" and "low" contact with a neutral position.
Barber-Colman Co., Rockford, Ill.

Tin Content—*Bulletin F5605-3* describes the Wheelco Portable Tin Content Indicators designed and developed to fill the need of a unit for a quick analysis of solder quality.
Barber-Colman Co., Rockford, Ill.

Vidigage—Four-page folder on the "Vidigage" ultrasonic resonance thickness gage.
Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

Tape—A new type magnetic storage device which combines the advantages of a magnetic drum and tape recorder is detailed in a new folder.
Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Controls—A wide range of pressure, hydraulic, temperature, process, and combustion controls is described in a new four-page bulletin.
A. W. Cash Co., P. O. Box 551, Decatur, Ill.

Mechanical Pressure Gage—This compact instrument has been designed to measure mechanical pressures or compressive loads even in very limited space. *Request Bulletin PG-4.*
W. C. Dillon Co., Inc., P. O. Box 3008, 14620 Keswick St., Van Nuys, Calif.

Glass—*Doerr Glass News*, the first in a series of news type bulletins devoted to scientific laboratory glassware.
Doerr Glass Co., Vineland, N. J.

Dimensional Stability of Photographic Film—A new Eastman Kodak publication, *Dimensional Stability of Photographic Film*, of special interest to the graphic arts industry is now available for distribution.
Sales Service Div., Eastman Kodak Co., Rochester 4, N. Y.

Stopper and Cork Borer—Rubber stoppers as well as corks up to 4 in. diameter are bored smoothly with versatile new Stopper and Cork Borer.
Eberbach Corp., Ann Arbor, Mich. Request Bulletin 600.

Precision Meter—This instrument has high accuracy over a very wide range, 0.01 ohm to 100,000,000 ohms, is completely self-contained, and easy to operate.
Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

Filled Thermal Systems—The complete line of Fischer & Porter filled thermal systems for indicating, recording, controlling, transmitting, compensating, and programming temperatures from −400 to +1000 degrees Fahrenheit are illustrated and described in *Catalog 12-A-10.*
Fischer & Porter Co., Hatboro 35, Pa.

Storage Racks and Bins—*Special Data Bulletin 105-ASTM* has comprehensive illustrated information, complete architectural specification data, full technical details for heavy duty industrial storage requirements.
Bernard Franklin Co., Inc., 3110 E. Hedley St., Philadelphia 37, Pa.

Glass Filters—*Glass Fiber Filter Discs*, a four-page, two-color bulletin covering a complete range of septa for every commercial use.
Friedrich and Dimmock, Inc., Millville, N. J.

Photometric Unit—*Bulletin No. 161* which gives complete and up-to-date information on the Gardner Automatic Photometric Unit and Precision Exposure Heads for use with same.
Gardner Laboratory Inc., 4723 Elm St., Bethesda 14, Md.

Fusible Service Entrance Equipment—Two-color, 16-page *Bulletin GEA-6286* describing G. E.'s new line of fusible service entrance equipment explains the feature of seven basic types of fusible service entrance devices for commercial and light industrial applications.
General Electric Co., Trumbull Components Dept., Plainville, Conn.

Resolution Test Patterns on Glass—Precision targets consisting of progressions of line spacings, widely used as a method for determining the resolving power of photographic lenses and other equipment.
W. & L. E. Gurley, Troy, N. Y. Request Bulletin 8000.

High Pressure Equipment—*Catalog No. 2055* fully describes the rapidly expanding line of high pressure valves, adaptors, reactors, autoclaves, thermo-couplings, gages, fittings, and tubing.
High Pressure Equipment Co., Inc., Erie, Pa.

Precision Stirrer Assemblies—Eight-page bulletin describes recently modified precision stirrer assemblies.
Kontes Glass Co., Vineland, N. J.

Revolving Shelf Oven—A new revolving shelf oven (*Bulletin 3900*) for use with ASTM Test Method for Determination of Loss on Heat of Oil and Asphaltic Compounds (D 6).
Labine, Inc., 3070 82 W. Grand Ave., Chicago 22, Ill.

Polyethylene Sink Trap—Data sheet describes new model Lanco polyethylene sink trap including design changes, construction, chemical and physical properties of polyethylene material, and installation procedure.
Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

Portable Potentiometers—Complete information about single, double, and triple range portable potentiometers, widely used for numerous emf measurements in plant and laboratory, is now available in a two-page *Data Sheet E-51(2).*
Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Electronics—Plant facilities, typical capacitor products, key company personnel and a brief summary of a 31-year history of serving the electronics industry are contained in a new 12-page, two color booklet.
Mica Mold Electronics Manufacturing Corp., 1087 Flushing Ave., Brooklyn, N. Y.

Burn Kit—The M-S-A Foille Burn Kit, for immediate treatment of all types of burns, is described in a newly published *Bulletin No. 04023.*
Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

Enclosed Switches—New 28-page *Catalog No. 83*, covering a complete line of industrial enclosed switches.
Micro Switch, Freeport, Ill.

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(Continued from page 76)

Thermocouples—*Specification Sheet 57* describes new two-wire thermocouples, with outside diameters of ⅛ in. and $\frac{3}{16}$ in.
Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Forgings—A bulletin entitled *Product Examples* illustrates a variety of different forgings produced at National Forge for industry.
National Forge & Ordnance Co., Irvine, Warren Co., Pa.

Printed Circuitry—Just reprinted is a bulletin, *Mechanize Your Wiring. . .with Copper-Clad Phenolite*, covering the advantages of printed circuitry for electrical and electronic systems.
National Vulcanized Fibre Co., 1055 Beech St., Wilmington 99, Del.

Vacuum Pumps—*Catalog No. 425* of complete line of high-vacuum pumps, featuring an engineering section containing formulae and data of practical value to all vacuum engineers.
Kinney Manufacturing Div., The New York Air Brake Co., 3640 Washington St., Boston 30, Mass.

Electron Microscopes—Eight - page booklet titled *Questions and Answers on Electron Microscopes.*
Research and Control Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Snubber—Pressure snubber, heretofore made only in brass, is now also available in stainless steel in response to a growing demand. This unit protects sensitive gages from sudden pressure changes (*Catalog File 1191A11*).
Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Accumulators—Piston - type accumulators and newly announced precharging accessories now offered in Parker *Catalog 1536.*
H. E. Lewis, Industrial Hydraulics Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Fitting for Instrumentation Tubing—Flareless-type tube fitting, designed especially for copper instrumentation lines and designated the "Intru-lok." *Catalog 4324.*
W. D. Wynant, Tube & Hose Fitting Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio.

Bombs—Replacement parts for all Parr bombs, calorimeters, and pressure reaction apparatus are shown in new 12- and 16-page illustrated *Price Lists, 55-1 and 55-2.*
Parr Instrument Co., 211 53rd Street, Moline, Ill.

Redesigned R.V.P. Bombs—*Data Sheet No. 11526* on the recently redesigned Reid Vapor Pressure Bombs for testing aviation and natural gasolines, benzol blends, and similar volatiles (ASTM Method D 323) and for testing liquefied petroleum gases according to ASTM Method D 1267.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Proximity Meter—A precision electronic instrument that measures without touching the specimen is described in a new 28-page booklet.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.

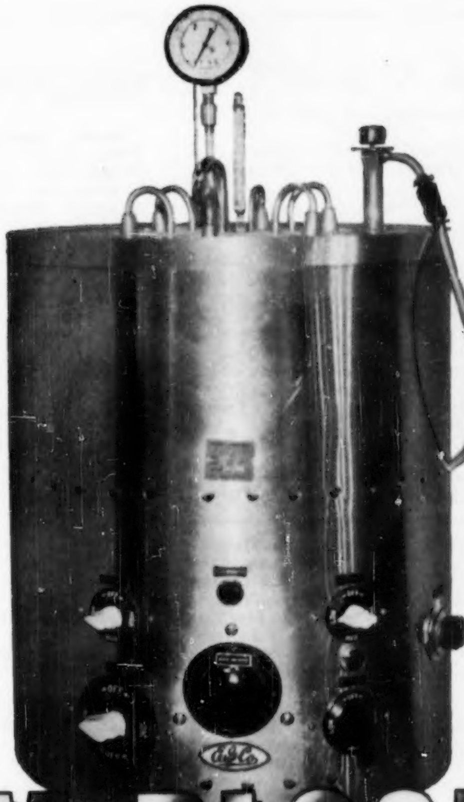
Controlled Volume Pumps—*Bulletin H20-1* describes controlled volume pump model H-20 designed for accurate chemical feed at low cost.
Milton Roy Co., Station H, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Paper Capacitors — Subminiature "Metal-Clad" metallized paper capacitors, *Bulletin 224*, providing reliability in high temperature (125 C) operation.
Technical Literature Section, Sprague Electric Co., Marshall St., North Adams, Mass.

Recording Charts—*Technical Notes*, a compilation of bulletins featuring specifications for "special" recording charts to be used by instrument people when designing their own recording instruments.
Lloyd Mansfield Co., Inc., 110 Pearl St., Buffalo 2, N. Y.

Catalog Supplement—A 264-page Supplement to 1472-page general catalog.

(Continued on page 80)



Lab Supplies

(*Continued from page 78*)

Supplement and catalog combined offer an up-to-date listing of more than 22,000 items.

Arthur H. Thomas Co., Philadelphia, Pa.

Tables Data—New booklet entitled *Selected Scientific and Engineering Tables and Data* and issued in commemoration of the 75th anniversary of the United States Testing Co. is composed of many kinds and types of technical information, reflecting the many fields of activity of this diverse testing organization.

H. M. Block, The United States Testing Co., 1415 Park Ave., Hoboken, N. J.

INSTRUMENT COMPANY NEWS

American Agile Corp., Maple Heights, Ohio—The addition of more than 10,000 sq ft of manufacturing and research area to its present facilities was announced by J. A. Neumann, president of the American Agile Corp. The new addition, when completed early this fall, will nearly double the existing plant facilities.

Aminco Sales Corp. of Pennsylvania, Philadelphia, Pa—A new subsidiary corporation of the American Instrument Co., Inc., Silver Spring, Md., has been formed to serve Eastern Pennsylvania, Southern New Jersey, and Delaware.

Barnes Engineering Co., Stamford, Conn.—Barnes Engineering Co. has been designated as the new name of Olympic Development Co., of Stamford, Conn. Although formerly established as the development division of Olympic Radio & Television Co., it is now an independent engineering and manufacturing company with R. Bowling Barnes, internationally noted physicist, as president. It is engaged in the development and production of infrared components and instrumentation for remote temperature measurement and control.

Barry Controls Inc., Watertown, Mass.—Barry Controls Inc. has acquired the Insco Co., of Groton, Mass., a small company known for its work in the development and manufacturing of electromechanical instruments and controls.

Beckman Instruments, Inc., Fullerton, Calif.—Beckman Instruments, Inc., has disclosed purchase of the Liston-Becker Instrument Co., Springdale, Conn., a leading manufacturer of infrared gas analyzers widely used in chemical research and industrial process control.

Braun Corp., Los Angeles, Calif.—Braun Corp., pioneer Los Angeles apparatus and chemical distributor, has moved to completely new quarters on a seven-acre tract at 1363 S. Bonnie Beach Place, just south of the Santa Ana Freeway in East Los Angeles.

Brush Electronics Co., Cleveland, Ohio—Curtis B. Hoffman has been appointed vice president sales of Brush Electronics Co., Cleveland, Ohio. Brush, a division of Clevite Corp., manufactures electronic instruments and is the country's largest producer of high-quality magnetic recording heads and piezoelectric crystals.

Central Scientific Co., Chicago, Ill.—Robert G. Picard has joined Central Scientific Co. as director of research and engineering development.

General Radio Co., Cambridge, Mass.—General Radio, for the convenience of its customers in the Philadelphia and Camden Areas, has opened a new Sales and Engineering Office at 1150 York Rd., Abington, Pa. Mr. Kipling Adams, for the past ten years in charge of the Chicago office, is opening the new Philadelphia District office.

G. M. Giannini & Co., Inc., Pasadena, Calif.—This manufacturer of aircraft and industrial electronic instruments, has leased large air-conditioned quarters on the 69th floor of the Empire State Building for its Eastern Sales Engineering Offices.

Inductotherm Corp., Delanco, N. J.—Inductotherm Corp., manufacturer of the Inducto line of high frequency heating

(*Continued on page 82*)

Lab Supplies

(*Continued from page 80*)

and melting equipment, has moved from Glenolden, Pa., to a larger, more modern plant at 412 Illinois Ave., Delanco, N. J.

Leece-Neville Co., Cleveland, Ohio—Wallace T. Gray has been appointed general works manager of the Leece-Neville Co., one of the world's largest manufacturers of small electric motors.

Leeds & Northrup Co., Philadelphia, Pa.—Elwood H. Rogge, assistant production manager of Leeds & Northrup Co., has been appointed local manager of the instrument firm's new plant at North Wales, Pa.

Potter Instrument Co., Inc., Great Neck, N. Y.—Due in part to the tremendous response by the electronics industry to the recent announcement of the Potter MAGNISTOR, Potter Instrument Co., Inc., has expanded production facilities to include 15,000 sq ft of additional production space.

Soiltest, Inc., Chicago, Ill.—Raymond Yong has joined the engineering staff of Soiltest, Inc., manufacturer of soils, concrete, and asphalt test apparatus.

Tenney Engineering, Inc., Union, N. J.—Ridgeway Engineering Associates, with offices in Chicago and Indianapolis, has been appointed by Tenney Engineering, Inc., to handle sales of specialized environmental test equipment in Illinois, Indiana, Iowa, Wisconsin, and part of Kentucky.

NEWS OF LABORATORIES

Vibro-Ceramics Corp., Metuchen, N. J.—A comprehensive consulting service in all phases of ultrasonics for industrial and scientific programs of any scope has been inaugurated by Vibro-Ceramics Corp., an affiliate of Gulton Industries, Inc., of Metuchen, N. J.

Illinois Institute of Technology, Chicago, Ill.—H. Zane Schofield has been appointed supervisor of the ceramics section in the ceramics and minerals research department at Armour Research Foundation.

U. S. Testing Co., Hoboken, N. J.—The United States Testing Co. announces the opening of a complete cotton fiber laboratory in Brownsville, Tex.

Bookshelf Cont'd

Permissible Dose from External Sources of Ionizing Radiation

National Bureau of Standards Handbook 59, 79 pp., 30 cents, Government Printing Office, Washington 25, D. C.

THE recommendations and discussions contained in this Handbook form the basis of all other recommendations of the National Committee on Radiation Protection; including permissible doses for radioactive material within the body, safe handling of radioactive materials, waste disposal, etc.

The Handbook presents discussions of the basic concepts of permissible dose and discussions of each of the many factors considered in the formulation of the recommendations. For easy reference the exposure limits of parts of the body to various types of ionizing radiation are briefly stated in the section "Protection Rules."

• • •

Photographic Dosimetry of X- and Gamma Rays

Margarete Ehrlich, National Bureau of Standards Handbook 57, 28 pp., 15 cents, Government Printing Office, Washington 25, D. C.

THE factual data and basic principles necessary for photographic dosimetry of X and gamma rays presented in the Handbook are the results of an extensive program conducted by the NBS Radiation Physics Laboratory.

Most of the information is concerned with the use of commercial photographic film for X- and gamma-ray dosimetry. Emphasis is placed on those properties of photographic emulsions that are basic to radiation dosimetry. Likewise, attention is called to limitations inherent in the methods and materials and to precautions that should be observed. Because considerable flexibility in techniques and procedures of film dosimetry is possible without appreciable effect on the end result, no attempt is made to specify all of the details uniquely.

• • •

Protection Against Radiations from Radium, Cobalt 60, and Cesium 137

National Bureau of Standards Handbook 54, 60 pp., 25 cents, Government Printing Office, Washington 25, D. C.

INCREASED applications of radium sources and the change in the maximum permissible dose have made necessary a revision of the radium protection code of the National Committee on Radiation Protection, National Bureau of Standards Handbook 23.

The general principles outlined for the sources covered in the enlarged scope of the Handbook will also be applicable to other gamma emitters as they become available and attenuation data are obtained for them. Industrial applications will be treated in a separate code; however, the basic principles and the attenuation data of this Handbook are applicable to both medical and industrial uses.

Calendar of Other Societies' Meetings

October 11–15—**SAE National Meeting,** Golden Anniversary Aeronautic Meeting, Aircraft Production Forum, and Aircraft Engineering Display, Hotel Statler, Los Angeles, Calif.

October 13–15—**Second Symposium on Vacuum Techniques,** Mellon Institute, Pittsburgh, Pa.

October 14–15—**National Society of Professional Engineers,** Fall Meeting, Peabody Hotel, Memphis, Tenn.

October 17–21—**ASM, AWS, AIME, Society for Non-destructive Testing,** 37th National Metal Exposition and Congress, Convention Hall, Philadelphia, Pa.

October 24–25—**Steel Founders' Society of America,** Fall Meeting, The Greenbrier, White Sulphur Springs, W. Va.

October 24–26—**ASA and National Bureau of Standards,** Sixth National Conference on Standards, Sheraton Park Hotel, Washington, D. C.

October 24–28—**American Society of Civil Engineers,** Annual Convention, Statler Hotel, New York City.

October 27–28—**National Conference on Industrial Hydraulics,** 11th Annual Meeting, LaSalle Hotel, Chicago, Ill.

October 31–November 2—**National Lubricating Grease Institute,** Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

October 31–November 2—**Packaging Institute,** 17th Annual Forum, Hotel Statler, New York City.

November 1–3—**Investment Casting Institute,** Fall Meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

November 2–4—**Society of Rheology,** Annual Meeting, New York City.

November 2–4—**ACS Div. of Rubber Chemistry,** 68th Mtg., Bellevue Stratford Hotel, Philadelphia, Pa.

November 2–4—**SAE National Meeting**—Golden Anniversary Diesel Engine Meeting, The Chase, St. Louis, Mo.

November 8–11—**American Council of Independent Labs., Inc.,** Annual Meeting, Westward Ho! Hotel, Phoenix, Ariz.

November 9–10—**SAE National Meeting**—Golden Anniversary, Fuels and Lubricants Meeting, The Bellevue Stratford, Philadelphia, Pa.

November 9–12—**Society of Naval Architects & Marine Engrs.,** 63rd Annual Meeting, Waldorf Astoria, New York City.

November 13–18—**American Society of Mechanical Engineers,** 75th Anniversary Meeting, Congress & Hilton Hotels, Chicago, Ill.

November 13–18—**American Rocket Society,** Annual Meeting, Congress, Hilton & Blackstone, Chicago, Ill.

November 14–17—**American Petroleum Institute,** 35th Annual Meeting, San Francisco, Calif.

November 16–18—**Soc. for Experimental Stress Analysis,** Annual Meeting, Hotel Sheraton, Chicago, Ill.

November 22—**Manufacturing Chemists' Assn.,** Semiannual Meeting, New York City.

November 25–26—**American Physical Society,** Chicago, Ill.

Nov. 27–30—**American Institute of Chemical Engineers,** Annual Meeting, Statler Hotel, Detroit, Mich.

NEW! Universal Z-Y Bridge

Measures Impedance . . .

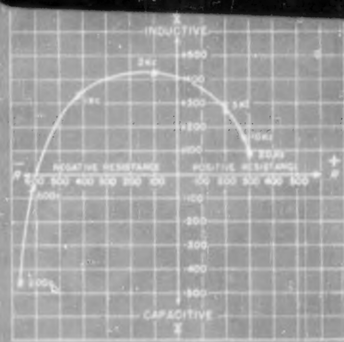
- from 0 to ∞ ohms
- balanced or grounded
- positive or negative
- at any phase angle
- over 20-cps to 20-kc range

The Type 1603-A Z-Y Bridge is the latest addition to the G-R line of precision impedance-measuring apparatus.

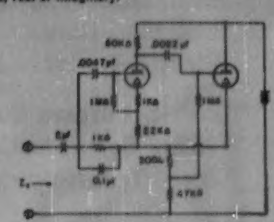
This Universal Z-Y Bridge will measure any impedance — from short circuit to open circuit, at small or large phase angle, and with a basic accuracy of 1% over most of this very wide range. Quadrature components of impedance, R & X or G & B, are measured directly at calibrated 100c, 1kc and 10kc bridge positions. Measurements at other frequencies over the 20 to 20,000 cycle range are made simply by multiplying reactance X or susceptance B readings by a factor which takes into account the difference between operating frequency and frequency setting of the Bridge selector switch.

The ability to measure impedances of any magnitude and with good accuracy with the same instrument can be an extremely valuable asset in many measurement situations. The Z-Y Bridge can be used by chemists for measuring conductivity of liquids in dielectric cells as readily as it can be used for ordinary R-L-C component measurements in the laboratory or production-test department. It will measure . . . open-and short-circuit transformer parameters . . . impedances of batteries and electrolytic capacitors . . . characteristics of audio-transmission networks . . . motional impedance of electro-acoustic transducers . . . Q and resonant frequency of chokes . . . and impedances of feedback loops, since negative real parameters are directly measured.

The Bridge also can be used to determine cable-fault locations and circular-arc plots of liquids or solids having lossy polarizations in the audio-frequency range. These are but a few of the countless applications for this unique and versatile device. *You name it — this Z-Y Bridge can probably measure it!*



Plot of Impedance Z_x of Feedback Circuit . . . . illustrates ability of the Z-Y Bridge to measure any impedance; quadrature components may be positive or negative, real or imaginary.



SPECIFICATIONS

Frequency Range — 20 cycles to 20 kc

Impedance and Admittance Range —
R: ±1000 ohms G: ±1000 μmhos
X: ±1000 ohms B: ±1000 μmhos

Accuracy —
R or G: ±(1% + [1 ohm or 1 μmho])
X or B: ±(1% + [$\frac{f_0}{f}$ ohm or $\frac{f}{f_0}$ μmho])

f is operating frequency, f_0 is frequency setting of panel selector switch

Impedances of less than 100 Ω (or 100 μmhos) can be measured on "Initial Balance" dials with considerably greater accuracy —
R or G: ±(1% + [0.2 $\frac{f_0}{f}$ ohm or 0.2 $\frac{f}{f_0}$ μmho])
X or B: ±(1% + [0.2 $\frac{f_0}{f}$ ohm or 0.2 $\frac{f}{f_0}$ μmho])

Maximum Applied Voltage — 150 volts, rms

Accessories Recommended —
Type 1210-B Unit R-C Oscillator and Type 1212-A Unit Null Detector

Accessories Supplied —
2 Shielded Cables for generator and detector

Dimensions — 12½" x 13½" x 8½"

Net Weight — 21½ lbs.

Type 1603-A Z-Y Bridge — $335.00

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ASTM BULLETIN

The Journal of the American Society for Testing Materials

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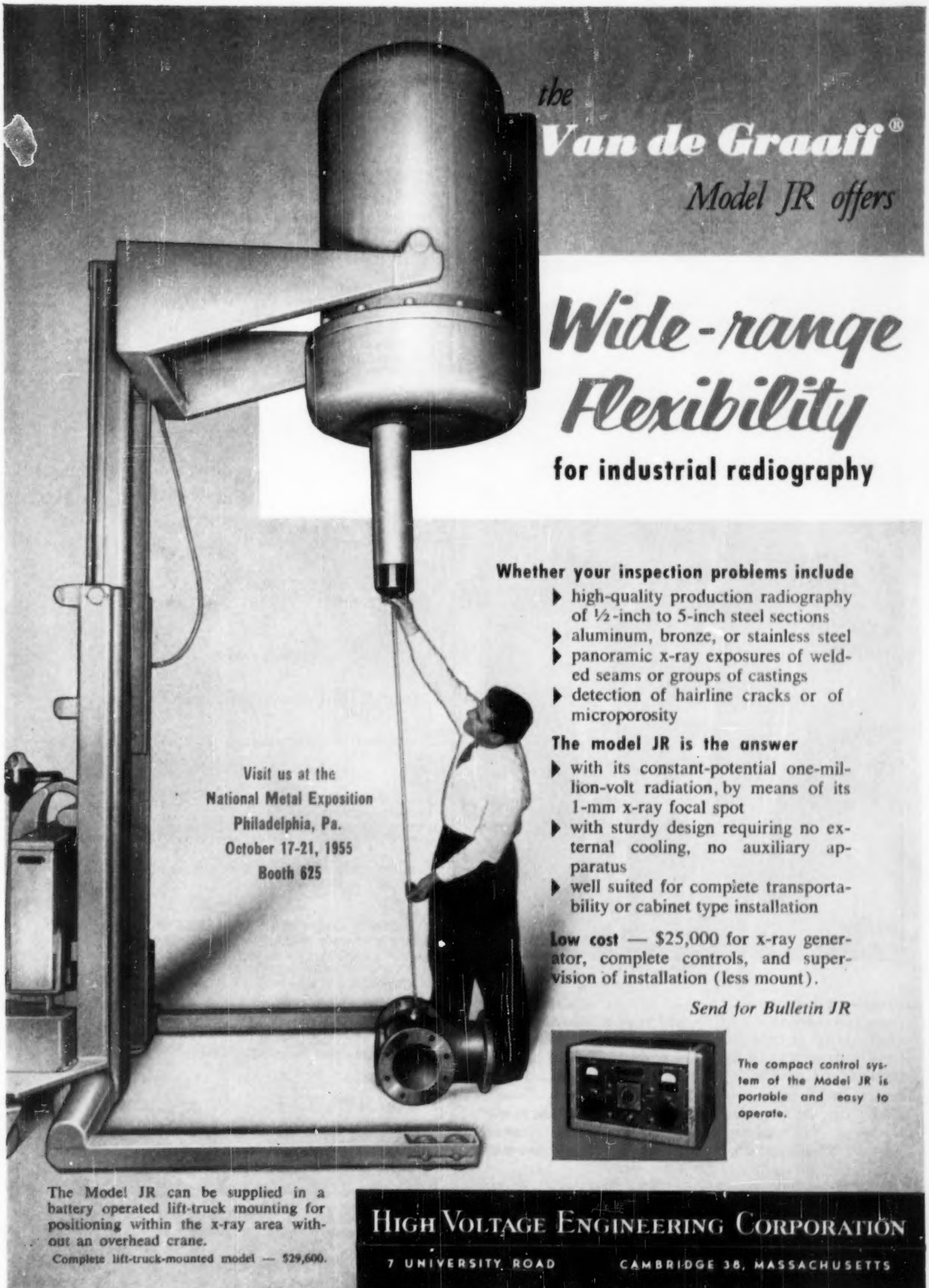
Each "*" indicates five consecutive years of advertising.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Model JR offers
Wide-range Flexibility
for industrial radiography
Whether your inspection problems include
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▶ panoramic x-ray exposures of welded seams or groups of castings
▶ detection of hairline cracks or of microporosity
The model JR is the answer
▶ with its constant-potential one-million-volt radiation, by means of its 1-mm x-ray focal spot
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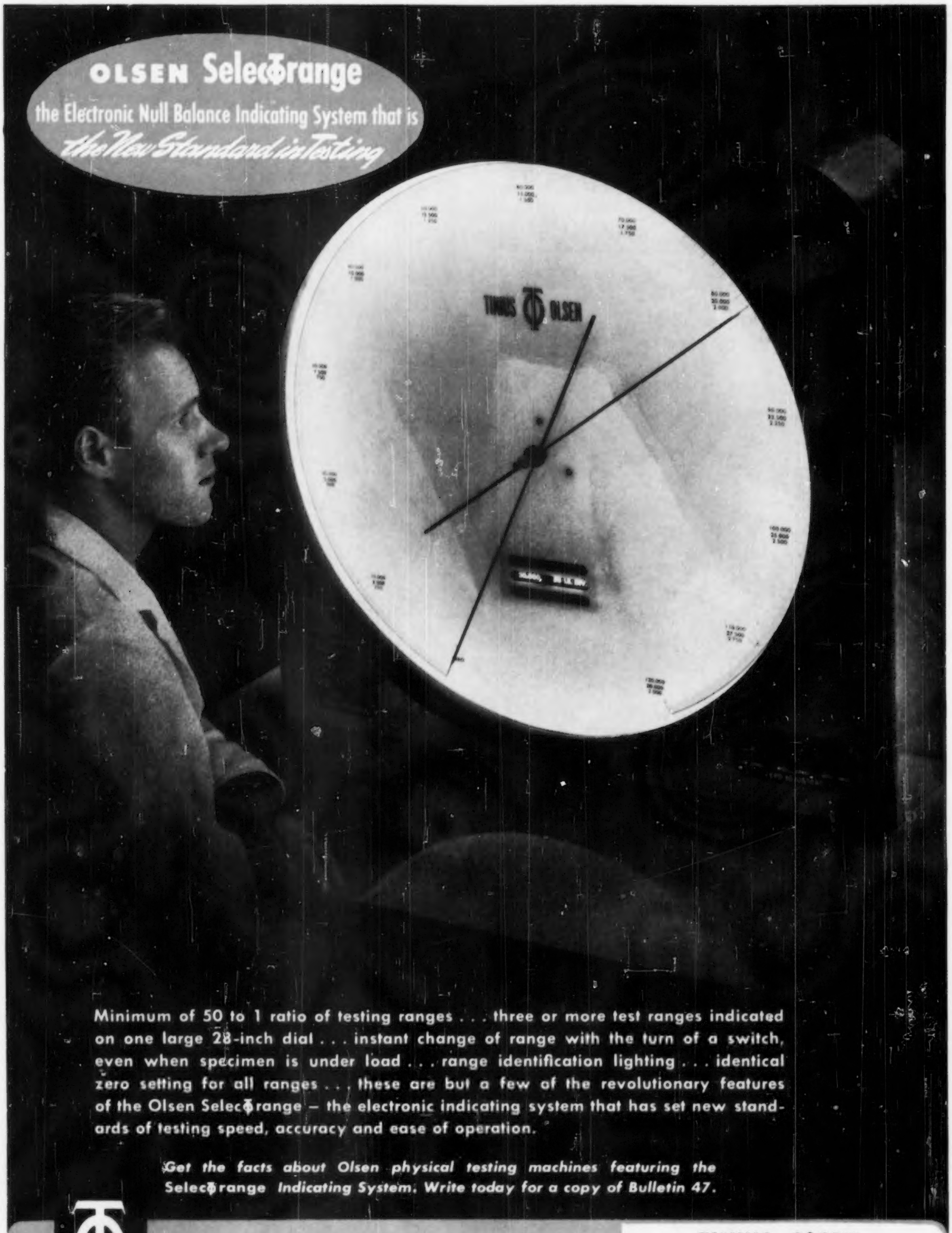
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